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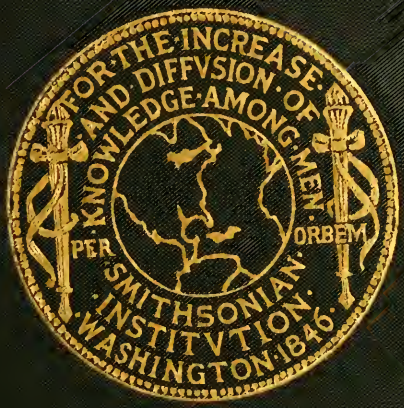

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REVISION OF THE FISHES OF THE FAMILY LIPARIDAE

BY

VICTOR BURKE
Of the State College of Washington
Pullman

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The present work forms No. 150 of the *Bulletin* series.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *April 19, 1930.*

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REVISION OF THE FISHES OF THE FAMILY LIPARIDAE

By Victor Burke

Of the State College of Washington, Pullman

INTRODUCTION

The following report consists of a biological and taxonomic study of the fishes belonging to the family Liparidae. The writer, as an assistant upon the United States Bureau of Fisheries steamer *Albatross* during the Japanese cruise of 1906, became interested in the many new and peculiar species of Liparidae that were continually being brought up by the dredge. Later, when assisting in the preparation of reports on these fishes, it became evident that the published accounts of the Liparidae were very unsatisfactory and that with the acquisition of so many new species a thorough review of the family would be most timely. It was seen also that the Liparidae, represented as it is at all depths from the tide pools down to 2,000 fathoms, is a faverable group in which to study the modification of structure and color due to the enviornment of the deep sea. This led to the extension of the subject matter of the report into two parts.

Part 1 consists of (1) a general account of the modification of structure and color throughout the family; (2) the distribution, both horizontal and bathymetrical; (3) the relation between the bathymetrical distribution and the coloration; (4) summary.

Part 2 consists mainly of a taxonomic review of the family. The descriptions of those species which have been adequately described elsewhere have been reduced to a brief synopsis of important characters together with an account of the distribution and a discussion of relationships. Keys to the genera and species are included. In addition the taxonomic value and modification of the specific characters of the three genera, Liparis, Careproctus, and Paraliparis, are described.

Genera.—Thirteen genera are recognized in this report. A number of the old genera have been reduced to synonomy. I have followed Garman and other writers in not recoginzing *Neoliparis* Steindachner. The notch in the dorsal fin, upon which this genus was based, is not of specific value in *Liparis dennyi* and other inter-

mediate forms. *Prognurus* Jordan and Gilbert and *Bathyphasma* Gilbert are reduced to the synonomy of *Careproctus*. *Prognurus* was based upon the forked caudal, but with the discovery of *Careproctus furcellus*, a species with a slightly forked caudal, the gap between *Prognurus* and *Careproctus* is closed up. *Bathyphasma* was based upon the character of the teeth, but these in no way differ from the teeth of several species of *Careproctus*. *Amitra* Goode and *Hilgendorfia* Goode and Bean are referred to the synonomy of *Paraliparis*. *Amitra* is described as differing from *Paraliparis* solely in the presence of pseudobranchiae. I have been unable to demonstrate the presence of pseudobranchiae in *Amitra liparina* and doubt their presence in any of the specialized species of the family. *Hilgendorfia* is supposed to differ from *Paraliparis* in the forward extension of the dorsal ridge and possibly in the character of the pectorial fin. These characters do not appeal to the writer as being of generic value. *Crystallichthys* Jordan and Gilbert and *Gyrinichthys* Gilbert are provisionally retained as genera. *Crystallichthys* was described as differing from *Liparis* chiefly in the single nostril. I have shown that it agrees with *Careproctus* in the character of nostril and teeth. It is retained as a genus because of the peculiar slitlike pupil and the coloration. *Gyrinichthys* differs from *Careproctus* solely in the reduced gill slit and will have to be reduced to synonmy upon the discovery of a species of *Careproctus* with a gill slit but slightly smaller than that of a number of known species.

One new genus (*Temnocora*) is described in this report. Five new genera have recently been described and should be mentioned here. Gilbert and Burke (1912) describe the three remarkable genera, *Elassodiscus*, *Acantholiparis*, and *Nectoliparis*. Burke (1911) describes the genus *Polypera*. Gilbert (1915) describes the genus *Lipariscus*.

Species.—In the present report 114 species (including the appendix) are recognized. Specimens of 90 of these species have been examined by the writer. Many of the species are represented by but a single or few individuals; 29 species of those examined are represented by a single individual, 13 species by 2 specimens each, and 64 species by 5 or less specimens each. This lack of material has caused to be left undecided the fate of a number of doubtful species. Other writers may disagree as to the importance of certain variations and of the validity of some of the species recognized here. Several doubtful species have been recognized and so indicated. When a name is in print it is best to recognize it until it can be reduced to synonomy with absolute certainty. With a series of types before one, the species which can not, or only doubtfully, be identified by the descriptions appear distinct. The more we know of the species and the more species we know the greater the difficulty of distinguishing

them by keys and descriptions. No one familiar with these fishes should expect to identify them easily without correctly labeled specimens at hand.

The serial arrangement of the species differs from that presented in any previous report. The large amount of material available has made possible a careful study of the taxonomic value of all specific characters. This has led to a clearer conception of the relationship of the species. Many of the species, however, are based upon such a combination of characters that it is difficult to trace out the different lines of development. This accounts to a large extent for the different views presented by writers concerning the relationship of various species.

Descriptions.—The specific descriptions are written in a uniform manner in order to facilitate comparisons.

In the measurements the length is given in millimeters and refers to the distance between the tip of the snout and the tip of the caudal fin. The other measurements are given in tenths of the length of the body minus the caudal fin and of the length of the head. The comparative measurements of certain parts proved to be of little or no value. Of these some have been included and others omitted. Of those omitted we refer to the length of the caudal fin, snout to dorsal, snout to vent, pectoral to dorsal, interorbital width and disk to vent. We have omitted some measurements in the species of one genus and included them in the species of other genera because they proved to be of greater value. See diagram illustrating the method of taking measurements. The number given after "Locality" refers to *Albatross* stations unless otherwise stated.

These fishes are somewhat difficult to describe on account of the texture of the body. Quite a few mistakes have been made in identification and description. Many of the United States National Museum specimens were found to be incorrectly labeled, and it was not uncommon to find more than one species, and sometimes two genera, in one bottle. This collection included eight undescribed species and the very aberrant genus *Nectoliparis*. In the deep-sea forms the dorsal and anal fins have to be dissected, sometimes under water, in order to make accurate counts. The teeth should be mounted on a slide and examined with the microscope. The microscope and a powerful hand lens are necessary when working with these fishes. Some of the important characters are lost with the maceration of the skin.

The distribution of the species as given is based solely upon the material examined unless otherwise stated. As practically all the material in America has been examined by the writer, records other than those given here should be viewed with suspicion as possibly the result of misidentification.

The synonomy given is based mainly upon the material examined. This is the only satisfactory method of dealing with these fishes. It is extremely difficult or impossible to decide upon the specimens listed by others. The synonomy of the American and Asiatic species is easily traced out, but that of the European species is impossible without an examination of the material in the museums of Europe.

The material upon which this report is based consists of the collections in the American Museum, the Museum of Comparative Zoölogy, the United States National Museum, United States Bureau of Fisheries, and the Stanford University Zoological Museum. Altogether about 830 specimens have been examined, and these represent 90 species. The collections well represent the family and form a satisfactory basis from which to build a monographic report.

The drawings of the teeth were made by W. L. Atkinson, under a grant from Stanford University, from camera lucida drawings by the writer.

A bibliography consisting of the most important papers relating to these fishes is appended.

I wish to acknowledge my indebtedness to Dr. David Starr Jordan, Dr. C. H. Gilbert, Dr. Bashford Dean, and Dr. Samuel Garman, for assistance and advice received during the preparation of this report. Dr. Peter Schmidt of the Imperial Museum of St. Petersburg, and Shigeho Tanaka, of the Imperial University of Tokyo, very kindly sent material for examination Mr. Barton A. Bean, of the United States National Museum, gave the writer every assistance possible in the examination of the collection in his charge.

PART 1. GENERAL

The Liparidae or sea snails comprise a group of softbodied degenerate fishes related to the Cyclopteridae and Cottidae. They agree with the Cyclopteridae and differ from the Cottidae in having the ventral fin modified into a sucking disk. In some of the deep-sea genera the disk has become lost. The Liparidae and Cyclopteridae had a common origin and closely resemble each other. The former can be distinguished from the latter by the more slender, shorter trunk and the more elongate caudal region.

These fishes are specialized for a bottom existence both in the shallow waters and the deep sea. Only one species is known to belong to the plankton. This species, *Nectoliparis pelagicus*, is found in mid-ocean between 300 and 600 fathoms. The most familiar species are those found in the tide pools, where they rest under or cling to the rocks.

Collecting.—The tide-pool species are sluggish and easily captured. The turning over of rocks along the shore frequently exposes species which can readily be seized. Baling out tide pools or sprinkling in

chloride of lime brings these and other fishes into view, when they can be picked up with a dip net or a strong pair of forceps.

Preservation.—Special care should be taken in hardening these fishes. If not properly treated they soon macerate and identification then becomes difficult. Many of the museum specimens examined were in a deplorable condition and practically valueless. The best results are obtained by hardening overnight in a 3 to 5 per cent solution of formalin, then washing off in water and running through alcohol up to 75 per cent. The formalin should not be strong enough to swell the tissues. If placed in strong alcohol, without first hardening, the specimens quickly shrivel and lose their normal appearance. If permanently preserved in formalin a more lifelike appearance is retained. This is especially true of the deep-sea species, which soon lose their gelatinous appearance if preserved in alcohol.

Historical.[1]—The most comprehensive account of these fishes in recent years is the work of Garman on the Discoboli, 1892. This has been followed by a review of the deep-sea species by Goode and Bean in Oceanic Ichthyology, 1895. Jordan and Evermann give a review of the North American species in their Fishes of Middle and North America, 1898. The few known Asiatic species are described by Peter Schmidt in Pisces Marium Orientalium, 1904. A large number of smaller papers contain notes and descriptions dealing with these fishes. The Europeans, lacking the wealth of material found in America, have contributed but few descriptions and notes.

Jordan and Evermann, 1898, say that there are "Genera 9; species about 40." Since that time the number of genera has been increased and the number of species more than doubled. In the present work the writer recognizes 13 genera and 114 species. In 1906 the *Albatross* collected 4 new genera and 32 new species. With the discovery of *Acantholiparis* and *Nectoliparis* our knowledge of the amount of modification within the family has been greatly extended. It seems safe to predict that with further exploration of the Antarctic and deep-sea regions the number of genera and species will be considerably increased.

In order to facilitate a comparison of the species described by Garman in the Discoboli, 1892, and those recognized by the writer the following table of species is given. It indicates the writer's conception of the species listed by Garman. It refers solely to the specimens in the museum and not to the synonomy. It was a surprise to find that Garman was able to produce such splendid work with such a small amount of material. It seems advisable also to give a table of the species listed by Evermann and Goldsborough in their Fishes of Alaska,

[1] For a more complete historical account, see Gill, 1891, and Garman, 1892.

1907, as their report is full of errors and misleading as to distribution of the species.

Discoboli:[2]	Liparidae
Liparis montagui	*Liparis montagui* (European).
	Liparis atlanticus (American, pl. 7).
Liparis mucosus	*Liparis mucosus* (California, pl. 5, figs. 1–5).
	Liparis callyodon (Alaska and Siberia).
Liparis callyodon	*fucensis* (pl. 6, figs. 1–5).
Liparis liparis	*Liparis liparis* (European).
	Liparis atlanticus (American, pl. 7).
Liparis antarctica	*Liparis antarctica* (pl. 6, figs. 6–10).
Liparis agassizii	*Liparis agassizii* (Japanese, pls. 1–2–3).
	Liparis gibbus (some of Bean's specimens).
Liparis tunicatus	*Liparis tunicatus.*
Liparis steineni	*Liparis steineni.*
Liparis pulchellus	*Liparis pulchellus* (pl. 4, figs. 6–8).
Careproctus major	*Liparis major.*
Liparis pallidus	*Careproctus pallidus.*
Careproctus micropus	*Careproctus micropus.*
Careproctus gelatinosus	*Careproctus*, not recognized.
Careproctus reinhardi	*Careproctus reinhardi* (Arctic Ocean).
	Careproctus ranula (Halifax Harbor).
Paraliparis rosaceus	*Paraliparis rosaceus.*
Paraliparis bathybuis	*Paraliparis bathybuis.*
Paraliparis liparinus	*Paraliparis liparina.*
Paraliparis membranaceus	*Paraliparis membranaceus.*

Fishes of Alaska:[3]	
Neoliparis rutteri	*Liparis rutteri* (fig. 99).
Neoliparis callyodon	*Liparis callyodon.*
	Liparis mucosus.
	Liparis rutteri.
	Liparis beringianus.
Liparis fucensis	*Liparis fucensis* (Station 4302).
	Liparis dennyi (4208, 4220, 4270, 4271, 4272, 4289, 4302, 4256, Hoods Canal).
Liparis agassizii	*Liparis bristolense* (Station 3247).
	Liparis gibbus (St. Paul Island, fig. 111).
Liparis herschelinus	*Liparis herschelinus* (pl. 18).
Liparis cyclostigma	*Liparis cyclostigma.*
	Crystallichthys cyclospilus (pl. 19).
Liparis pulchellus	*Liparis pulchellus.*
Crystallichthys mirabilis	*Crystallichthys mirabilis* (pl. 20).
Careproctus simus	*Careproctus simus.*
Careproctus colletti	*Careproctus colletti* (Station 3338).
	Careproctus spectrum (Station 4295).
Careproctus phasma	*Careproctus phasma.*
Careproctus spectrum	*Careproctus spectrum.*
Careproctus ostentum	*Careproctus ostentum.*
Careproctus ectenes	*Careproctus ectenes.*
Prognurus cypselurus	*Careproctus cypselurus* (pl. 20).

[2] Garman, Discoboli, 1892.

[3] Evermann and Goldsborough, Fishes of Alaska, 1907.

Gyrinichthys minytremus	*Gyrinichthys minytremus.*
Paraliparis holomelas	*Careproctus gilberti* (Stations 4292, 4293).
	Paraliparis deani (Stations 4194, 4203, 4251 4253, 4255, 4292, 4293).
	Nectoliparis pelagicus (Stations 4252, 4257 4258).
Paraliparis cephalus	*Paraliparis cephalus.*
Paraliparis ulochir	*Paraliparis ulochir.*
Rhinoliparis barbulifer	*Rhinoliparis barbulifer.*

DEFINITIONS AND MODIFICATIONS OF STRUCTURE

The structure of the Liparidae has been greatly modified as the species became adapted to the deep sea. The extent of these changes in structure throughout the family are briefly outlined in the succeeding pages. The definitions of the terms used and method of taking measurements are best illustrated by the following diagram of the external anatomy of a Liparid. For a discussion of the taxonomic importance of the specific character see under each genus.

Sexual dimorphism.—Few of the species are known to show sexual differences. In *Liparis atlanticus* and *Liparis rutteri* the males, and possibly the females to a less degree, at the breeding season have the anterior dorsal fin elevated and the male of the former species has the body covered with "thumb-tack" prickles. Of the other species with prickles some have them in both sexes but more commonly they appear to be confined to the male. The various color phases should be investigated in relation to sex.

Body.—The shape of the body varies widely. The species which live in the tide pools or very shallow water usually have a short, depressed, and comparatively firm body. The species of the greater depths typically are compressed, more elongate, and less firm. It may be said in a very general way that in the species of the very shallow waters the body is stout and depressed and the vertebrae are stout and few in number; that in species from somewhat greater depths the body is moderately stout, less firm, deepened and compressed and the vertebrae weakened and increased in number; and that in the greater depths the skeleton becomes greatly weakened, the flesh very soft and reduced, the body elongate and the vertebrae slender and in still greater numbers. The number of vertebrae varies from about 35 to 70. The genera, which in a general way illustrate these phases of modification, are *Liparis*, *Careproctus*, and *Paraliparis* with *Rhinoliparis*.

Careproctus best illustrates the production of pseudotissue which envelops the body and fins just beneath the skin. In these forms the skin is loosely attached to the body. In preserved specimens it frequently becomes detached and appears as a transparent sack about the body and bases of the fins.

Head.—The head is typically blunt though sometimes distinctly pointed as in *Liparis rhodosoma.* The snout is usually truncate, rarely projecting as in *Acantholiparis opercularis* and *Allinectes ectenes.* The lower jaw is typically included and the mouth horizontal. In *Paraliparis cephalus* and *Nectoliparis pelagicus* the lower jaw projects and the mouth is oblique. The projecting shovel-shaped

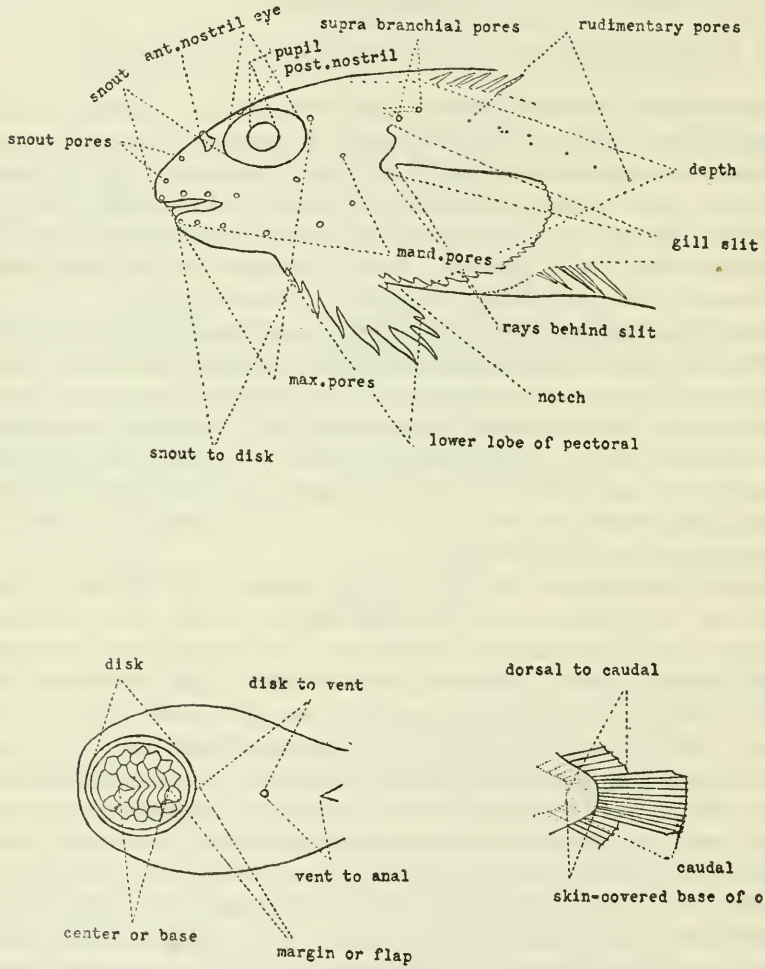

FIGURE 1.—DIAGRAMS SHOWING PARTS OF FISH

snout of *Acantholiparis opercularis* suggests a mud-bottom environment. The species of *Liparis* typically have the width of the head greater than the depth, the reverse being true of the majority of the remaining species, in which the head is compressed and the cheeks vertical. One species, *Acantholiparis opercularis,* has the opercular arms projecting as spines from the sides of the head. The lower

surface of the snout is split in *Crystallias matsushimae*. Barbels are present on the snout in this species and also in *Rhinoliparis*.

Eye.—The eye is distinctly larger in the deep-sea species. The average number of times the eye is contained in the head in *Liparis* is 6.5, in *Careproctus* 4, and in *Paraliparis* 3.8.

The color of the eye varies from black to silver. The silvery color apparently is confined mainly to the tide-pool and moderately deep-water species of *Liparis* and *Careproctus*.

The pupil is typically round or slightly oval. An exception is found in *Temnocora candida* in which the pupil is reduced to a slit. In *Crystallichthys mirabilis* and related species the pupil is a slit with the upper margin notched. These characters are constant, as the pupil of fishes is only slightly, if at all, subject to muscular control. With preservation or maceration the shape of the pupil may be modified.

Nostrils.—The nostrils are double in *Liparis* and *Polypera* and single in all the other genera, the posterior nostril being lost in the latter groups. The anterior nostril tube leads directly from the olfactory cavity to the surface and usually projects above. The posterior tube extends backward beneath the skin and opens above the anterior part of the eye. In some forms it projects above the surrounding surface and may have a fingerlike projection in front. The two tubes are sometimes nearly equal in length though one is entirely below the surface of the skin. In certain specialized species of *Liparis*, as in *L. major* and *L. tessellatus*, the posterior nostril opening is reduced and thus approaches the condition found in *Careproctus*. In *Liparis* and the more generalized species of *Careproctus* the anterior nostril tube typically projects high above the surface of the head; but in the more specialized forms of *Careproctus* and in *Paraliparis* the tube opens at the surface or projects slightly above.

Pores.—The lateral line in this family is reduced to 1 or 2 open pores above the gill slit, 2 on the snout, a series of 6 extending along the lower margin of the snout and eye to above the posterior margin of the eye, and a series of 7 extending from the tip of the lower jaw to the opercle. The pore formula may be designated as 2–6–7–2. In many species rudimentary pores are present on the sides and occiput. The rudimentary pores are present in many species of *Liparis* and *Careproctus*. Their presence in many of the more specialized members of the family has not been demonstrated. They may occur in a single series extending back from the suprabranchial pores or be somewhat scattered on the sides anteriorly and on the nape. Each consists of a small papilla, the apex of which may be indented or split, but there is never a distinct opening as in the other pores.

The taxonomic importance of the open pores has not been thoroughly investigated. They offer a promising field for further research and may be found to be of value in working out the genetic relationships of the genera. All of the species of *Liparis* and most of the species of *Careproctus* have two suprabranchial pores; a few of the species of *Careproctus* and all the species of *Paraliparis* seem to have but a single suprabranchial pore. All the genera derived from *Paraliparis* have but one suprabranchial pore. In certain species of *Careproctus* there seems to be a variation of from 2 to 1 suprabranchial pore. The pore formula of some species of *Paraliparis* is 2–5–6–1, as though the upper pore of the last three series had been lost. In certain species of *Liparis*, as in *L. rhodosoma*, the lower suprabranchial pore is reduced, but in some species of *Careproctus* it is the upper pore that has been reduced.

The position of the pores varies considerably. The suprabranchial pores are in some species separated by a distance greater than the eye, and in others they are very close together. The upper pore on the snout in *Liparis* is typically some distance in front of the nostril; in *Careproctus* it is closer to the nostril; in *Paraliparis* it may be between and in *Nectoliparis* above the nostrils. This appears to be due to a shifting of both the pores and the nostrils. The anterior snout pore lies either in front of the upper pore or in front and lateral to it. The snout pores and the nostril form the apices of variously shaped triangles. The anterior mandibular pores in certain species of *Careproctus* and *Paraliparis* have a common opening.

Gill slit.—In each of the three large genera, *Liparis*, *Careproctus*, and *Paraliparis*, we find the gill slit undergoing the same amount of variation from a position above the pectoral to one extending down in front of it. There is a difference, however, in the frequence with which the gill slit extends down in front of the pectoral. In *Liparis* two-thirds of the species have the gill slit enlarged and extending in front of the pectoral. The reduced gill slit is restricted mainly to the tide-pool species, the enlarged slit to the deeper-water and more specialized forms of the genus. About one-third of the species of *Careproctus* have the gill slit extending in front of the pectoral, and these are found in both the most generalized and specialized members of the genus. The gill slit is widest in the most specialized forms of this genus. An extreme reduction of the gill slit is found in *Gyrinichthys* in which it is high above the pectoral and no larger than the diameter of a dissecting needle. In only one species, *Nectoliparis pelagicus*, is the gill slit confined to the front of the pectoral.

Teeth.—The teeth exhibit a wide range of variation in shape, size of pulp cavity, and arrangement. The teeth may be either trilobed

or simple, and some species have both types. Species in 10 of the genera have trilobed teeth. In three of the genera the teeth range from trilobed to simple. In another genus, *Liparis*, (*major*), there is an approach to the same condition. The trilobed condition of the teeth is most typical of the shallow-water species. All the species of *Liparis* have teeth of this type. The simple teeth are more typical of the deep-water species. More than half the species of *Careproctus* and nearly all the species of *Paraliparis* have simple teeth. The teeth may be either thick and blunt or lanceolate. The thick, blunt teeth may be either trilobed or simple. The heavy crushing teeth of *Careproctus rhodomelas* are formed by the three lobes becoming thickened and united. In *Paraliparis atramentatus* the heavy, blunt teeth are the result of an increase in the diameter of the simple teeth. In nearly all the species with simple teeth the teeth are round in cross section. In the *Paraliparis rosaceus* group of species, however, the teeth are compressed and wedge shaped at the tip.

The teeth are typically arranged in pavementlike bands. The width of the bands and the number of oblique rows of teeth constituting the bands vary. In some of the species of *Careproctus* and *Paraliparis* the bands of teeth are very narrow and the number of oblique rows of teeth is reduced. Looking directly into the mouth from in front the rows of teeth are seen to diverge posteriorly. These are the oblique rows of teeth referred to in the descriptions. If, however, we view the teeth from the opposite direction we find them arranged in oblique rows which diverge anteriorly.

The bands of teeth usually present an oblique cutting surface. This is due to the anterior teeth being smaller and extending on the anterior surfaces of the mandibular and maxillary bones. A striking exception to this condition is found in the *Careproctus colletti* group of species. Here the teeth are set on a more horizontal surface, the anterior teeth are larger, and the inner teeth recurved. When the jaws are separated the cutting surface appears horizontal and the anterior teeth appear as large as the inner teeth. When dissected out the anterior teeth are found to be somewhat smaller.

The teeth are arranged in a single series in the *Paraliparis rosaceus* group of species and in *Nectoliparis pelagicus*.—In the *Paraliparis rosaceus* group of species the teeth are set close together and the tips are wedge shaped and form a sharp cutting edge. In *Nectoliparis pelagicus* the teeth are minute and difficult to examine, but they appear to be conical and more widely spaced than in *Paraliparis rosaceus*.

Pseudobranchiae.—The pseudobranchiae consist of about five filaments and are known with certainty to exist only in the genus *Liparis*. Goode, (1880, p. 478), records their presence in *Paraliparis liparina*, but this has been questioned by later writers.

Pyloric coeca.—Pyloric coeca are present in all the species except *Acantholiparis opercularis* (cf. *C. ectenes*). The number varies in *Liparis* from about 110 in *L. antarctica* and *L. liparis* to 70 or more in *L. agassizii* and other species. In the genus *Polypera* the coeca are fine and thickly matted about the pyloris and number about 300. In the more specialized genera the average number of coeca is less. This is readily seen by an examination of table on page 35. When the number of coeca is not more than 10 they are arranged in a single series which may not completely encircle the duodenum. In *Liparis* the coeca are on the right side of the visceral cavity and in the more specialized genera on the left side. This change of position is due to a shortening and shifting of the U-shaped stomach.

Branchiostegals.—The Liparidae have previously been described as having six branchiostegals. This is true for all but *Nectoliparis* and *Lipariscus* which have five, the interior one being absent in these genera.

Prickles.—Scales are represented by two types of prickles termed "thumb-tack" and "cactuslike" prickles. The former have been found in three genera—*Liparis*, *Careproctus*, and *Paraliparis*. The "thumb-tack" prickles consist of short spines with round, flat heads which are imbedded in the skin. The spines are lost with the epidermis but leave shallow pits in the dermis which indicate their presence in the specimen. These pits are easily seen on the thick-skinned specimens of *Liparis* but are obscure on the thin-skinned species of *Careproctus*. The "cactuslike" prickles are known to be present in four species of *Careproctus* and probably will be found in other genera. They consist of groups of spines arising close together in the dermis and bear a close resemblance to some found in the Cyclopteridae. (See Jordan and Starks, 1895, pl. 94.) The number of spines or prickles in each group may vary from 4 or 5 to 10 or more.

Dorsal fin.—In a number of the species the anterior dorsal rays are set off from the remainder of the fin by a notch. This notch is present in species of *Liparis*, *Careproctus*, *Polypera*, and *Temnocora*. It may be hardly evident or may extend to the base of the fin. In some species, such as *Liparis dennyi*, the dorsal notch is present in some specimens and absent from others.

The dorsal typically is connected to the caudal. In certain tidepool species the connection is short, not extending beyond the skin-covered base of the caudal. The other extreme is found in *Liparis pulchellus*, *tessellatus*, and *owstoni*, in which the connection is fully three-fourths the length of the caudal. In *Liparis* the connection with the cadual is usually abrupt and frequently notched. In the typical deep-sea genera the connection between the dorsal and the caudal is fairly constant, varying from 0.3 to 0.6 of the length of the latter.

The number of dorsal rays varies from about 28 or 30 in some species of *Liparis* to 65 or more in species of *Paraliparis*. An examination of the table on page 35 indicates that the number of dorsal rays is typically increased in the species inhabiting the deep water. The number of rays varies in *Liparis* from 28 to 48, in *Careproctus* from 39 to 61, and in *Paraliparis* from 48 to 66.

The anterior dorsal rays are primitively connected with the fin membrane, and the tips project above as in the pectoral fin. In many of the deep-water species, especially in *Careproctus*, the anterior rays are buried in tissue beneath the skin and free from it. Such rays are weak, and their tips frequently extend, undulating, backward to the succeeding ray.

All the dorsal rays are simple; that is, unbranched. A varying number of the anterior rays are also unsegmented. In the species examined the number of unsegmented rays varies from 6 to 18, and appears to be fairly constant for each species. The species of the more highly modified genera do not appear to have more unsegmented rays than the species of *Liparis*. (See following chart.) Some of the anterior rays in some of the species, especially those of *Liparis*, in addition to being unsegmented, are undivided, the two shafts or lateral halves of the ordinary ray being united to form a single rod.

The relation between the dorsal notch and the unsegmented and undivided rays is of some interest. The number of unsegmented rays usually, if not always, exceeds the number of rays in front of the notch. In some species only one or two of the rays behind the notch are unsegmented, while in other species there are as many or more unsegmented rays behind as in front of the notch. The number of undivided rays is always less than the number of unsegmented rays. It appears that the notch, in some species at least, marks the division between the undivided and divided rays, the rays in front of the notch consisting of a single rod and therefore spinelike.

In all the species in which the dorsal notch is present the rays in front of it appear to be unsegmented and undivided. We will now describe the condition of the anterior rays in those species in which the notch is absent. As previously mentioned, the anterior rays are always unsegmented. The question of their being undivided in those species in which the notch is absent has been investigated in but a few species. In *Liparis tunicatus* and *tanakae* the anterior dorsal rays are undivided and spinelike. This may represent the condition of these rays in all the species of this genus. In *Careproctus* and *Paraliparis*, more degenerate genera, some of the species have all the dorsal rays divided.

The significance of the dorsal notch and the unsegmented and undivided rays may now be considered. Does the dorsal notch mark the division between the ancestral spinous and soft dorsal? If so what is the significance of the unsegmented rays behind the

notch? In those species in which the notch is absent and all the rays are divided have the primitive spines, such as are present in front of the notch in *Liparis*, been lost or have they become modified to resemble the remaining unsegmented rays?

We can best approach the solution of the questions involved by an examination of the ancestral or related families. In the Cyclopteridae the dorsal notch appears to separate the spines from the soft rays. In some of the species the spinous dorsal is absent. The notch is always present when the spines are present. When the spines are absent it is very evident from the position of the first dorsal ray and the number of rays that the spines have been lost and not transformed into rays. In such forms the anterior dorsal ray bears the same relative position in regard to the first anal ray as the first ray of the soft dorsal bears to the first anal ray in the species in which the spinous dorsal is present. Also the number of dorsal rays in those species in which the spinous dorsal is absent is the same as the number of rays in the soft dorsal of those species in which the spinous dorsal is present. It also bears the same proportion to the number of anal rays. The number of anal rays remains fairly constant for both types of species. The dorsal notch in these fishes disappears, not as the result of the lengthening or shortening of certain rays, but as the result of their disappearance. The number of spines is small, usually eight or less. In the Agonidae also we find some species with the spinous dorsal absent. In the Cottidae the spinous dorsal is always present. In *Psychrolutes*, however, it is weak and buried in a ridge of skin. The number of spines varies from 6 to 18. A notch marks the change from the spinous to the soft dorsal. In some of the genera, as in *Chitonotus*, *Hemilepidotus*, *Blepsias*, and *Hemitripterus*, a second or anterior notch divides the spinous dorsal. In the Scorpaenidae the number of dorsal spines varies from 8 to 16. In the Hexagrammidae there are as many as 26 dorsal spines. In this family the notch is sometimes absent, as in *Pleurogrammus*.

From the above review of the condition of the dorsal fin in the principal families of the Loricati we are forced to consider the possibility that in the Liparidae all the unsegmented rays are homologous to spines such as are found in the Scorpaenidae. At least the large number of unsegmented rays, 15 or more, is not fatal to any such assumption. We have seen that species of both the Cottidae and Scorpaenidae may have as many as 16 or 18 and the Hexagrammidae as many as 26 spines. These famllies are less modified than the Liparidae and we may assume that a large number of spines is a primitive condition for the Loricati. It therefore seems probably that in the ancestry of the Liparidae there have been as many

spines as there are unsegmented rays in the living species. If so we may be dealing with the retention of a primitive condition of the dorsal fin and the unsegmented rays may be homologous to or represent the spinous dorsal of the hypothetical ancestor. There are, however, a number of serious objections to considering the unsegmented rays of the dorsal as primitive spines. These objections are as follows:

1. If the unsegmented rays represent spines we have the unusual condition of the notch dividing the spinous dorsal. In no other group in the Loricati do we find that, when only one notch is present, it divides the spinous dorsal. We have seen, however, that in some of the Cottidae two notches may be present and that the anterior one divides the spinous dorsal. The loss of the second notch would bring about the condition we are discussing the possibility of in the Liparidae. It is possible that this is what has occurred in the latter family. The presence of the notch in the middle of the unsegmented rays, while casting some doubt upon the theory that these rays represent spines, is not fatal to it.

2. In the Cyclopteridae, a family which is generally considered to be very closely related to and but slightly differing from the Liparidae, the dorsal notch separates the spinous and soft dorsal. The number of spines is small, eight or less, and about equal to the number of undivided rays in the Liparidae. Considering the close relationships between the Cylopteridae and Liparidae (some ichthyologists recognize but one family) and the apparent stability of the dorsal notch in the Loricati (if present in other families it divides the spinous and soft dorsal), we should expect to find the dorsal notch bearing the same relation to the spines and soft rays in these two families. The agreement in the number of spines in front of the notch in both families favors this view. If the spines in front of the notch in the Liparidae are homologous to the spinous dorsal of the Cyclopteridae, we can reasonably assume that the rays behind the notch in the Liparidae represent the soft dorsal of the Cyclopteridae. Therefore we can not consider the unsegmented rays behind the notch as representing ancestral spines, but should look upon them as having been modified independently in regard to segmentation.

3. The most important evidence contradicting the assumption that all the unsegmented rays represent a primitive spinous condition is obtained from a study of the anal fin. We find that the number of unsegmented rays in the anal fin varies from 1 to 12 or 16. None of the families of the Loricati have more than three anal spines. These spines are absent from the Cottidae and Cyclopteridae. We certainly can not homologize all the unsegmented anal rays with spines, but are forced to explain the loss of segmentation of these rays

as a newly acquired condition. If we are forced to explain the lack of segmentation of the anterior anal rays in this manner, it would be illogical to explain the condition of the unsegmented dorsal rays in any other manner without the support of very strong evidence. Such evidence is lacking except as regards the rays in front of the dorsal notch.

The dorsal rays in front of and possibly forming the notch appear to be homologous to spines. They differ from the unsegmented rays behind the notch in being undivided and rodlike. In the Cyclopteridae and Cottidae the notch separates the spines from the soft rays. We should expect to find the same condition in the Liparidae.

We may now discuss the fate of the undivided rays or spines in those species in which the notch is absent. We have seen that in the Cyclopteridae the absence of the dorsal notch indicates that the spines have been lost. The same is true of the Agonidae. In these two families the notch disappears only with loss of the spines. But in the Liparidae the notch may disappear and the spines be retained. This becomes very evident when we examine species like *Liparis dennyi*, in which the notch is faintly indicated or absent. In the species of *Liparis*, in which the notch is absent, it appears that the anterior rays remain undivided and spinelike. The absence of the notch in this genus does not indicate that the spines have been lost.

The fate of the undivided rays in *Careproctus* and *Paraliparis* is not so easily solved. In these genera, with a few exceptions, the dorsal notch is absent and the anterior rays are divided.[4] The absence of the notch in these species, judging from what has occurred in *Liparis*, does not indicate that the spines have been lost. There are two other criteria that we may use in determining whether the spines have been lost or become divided. These are the position of the origin of the dorsal and the number of rays.

The position of the origin of the dorsal in *Careproctus* and *Paraliparis* favors the view that the spines have not been lost. In the species of Cyclopteridae and Agonidae, in which the spinous dorsal is absent, the origin of the dorsal is proportionally farther back on the body. If the spinous dorsal has been lost in *Careproctus* and *Paraliparis* we should expect to find the origin of the dorsal farther back than in the species of *Liparis*, in which we know the spinous dorsal is present. The base of the spinous dorsal in *Liparis* is shorter than in the Cyclopteridae, but if this fin disappeared there would be

[4] We assume here that in the ancestry of these genera a dorsal notch and spines were present. In two of the known species of *Careproctus* a dorsal notch appears to be faintly indicated. The condition of the rays in these species has not been examined. We are justified in assuming, I think, that in the ancestry of these genera a dorsal notch and spines were at one time present.

a perceptible change in the position of the origin of the dorsal. The shape of the body is somewhat modified in *Careproctus* and *Paraliparis*, but this would hardly obliterate any change that might occur in the origin of the dorsal. The origin of the dorsal in *Careproctus* and *Paraliparis* is not perceptibly farther back than in *Liparis*. This indicates that in these genera the spinous dorsal has not been lost.

The proportional number of dorsal and anal rays also favors the view that the spines have not been lost in *Careproctus* and *Paraliparis*. In *Liparis* the number of dorsal rays (counting the spines) varies from four to nine more than the number of anal rays. Of these the anterior 4 to 7 or 8 are undivided or spinous. If these spines have been lost in *Careproctus* and *Paraliparis* the number of dorsal and anal rays should be about equal. But we do not find this to be true. In *Careproctus* the number of dorsal rays varies from 4 to 9 more than the number of anal rays. In *Paraliparis* the dorsal has from 3 to 10 more rays than the anal. The spinous dorsal apparently has not been lost in these genera. If the spinous dorsal has not been lost in these genera it possibly has not been lost in the other genera in which the notch is absent and the anterior rays divided.

From these general considerations we are led to believe that in the Liparidae the dorsal notch bears the same relation to the spines and soft rays as in the Cyclopteridae, that the rays in front of the notch, or the undivided rays, are homologous to ancestral spines and that the unsegmented rays behind the notch and the unsegmented anal rays can not be so homologized, but represent soft rays which have lost the segmented condition. The evidence concerning the fate of the spines in those species in which the notch is absent and the anterior rays divided seems to indicate that the spines have not been lost but have become divided. Assuming that spines have been formed from rays by the obliteration of the union of the two lateral shafts and the loss of segmentation we have, in these degenerated fishes, in the failure of the two shafts of the anterior dorsal rays to coalesce, an example of a retarded or reverted condition of a structure.

Table showing number of unsegmented dorsal and anal rays in specimens examined

Name	Length in mm.	Unsegmented dorsal rays	Unsegmented anal rays
Liparis callyodon	53	15	3
Do	40	14	2
Do	78	14	3
Do	95	14	3
Do	42	14	2
Do	55	15	4
Do	48	12	?
Liparis tunicatus	60	12	3
Do	100	11	1
Liparis herschelinus	?	10	2
Liparis atlanticus	70	[1] 7	?
Do	65	[2] 6	?
Do	95	[2] 7	1
Liparis rutteri	?	10	2
Liparis mucosus	82	15	4
Liparis dennyi	65	11	1
Polypera greeni	125	16	2
Do	230	16	3
Liparis agassizii	92	9	2
Do	125	7	1
Do	165	8	2
Liparis major	105	15	5
Careproctus gilberti	--------	15	7
Do	--------	12	6
Careproctus melanurus	--------	9	3
Careproctus sinensis	--------	15	3
Careproctus ranula	--------	14	4
Crystallichthys mirabilis	--------	?	12
Paraliparis copei	--------	18	16
Do	--------	?	8
Do	--------	13	10
Paraliparis deani	--------	9	4
Do	--------	11	4
Paraliparis cephalus	--------	10	6
Nectoliparis pelagicus	--------	18	12

[1] 5 in first dorsal. [2] 4 in first dorsal.

Anal fin.—The anal fin bears a close resemblance to the dorsal. The anterior rays appear to be spinous—that is, unsegmented. The number of unsegmented rays is greater in the more specialized genera. The connection with the caudal is nearly always greater than the dorsal connection with the caudal. The dorsal and anal are never continuous, the caudal always being distinct.

Caudal fin.—The posterior margin of the caudal is typically formed of about 10 rays, though there may be as many as 12 or 14. In addition to these there are in most species a number of rudimentary rays at the base of the caudal which may increase the number to 20.

The average number of caudal rays is slightly reduced in *Careproctus* and further reduced in *Paraliparis*. The greatest reduction of the caudal is found in *Rhinoliparis attenuatus*, where it is represented

by a single elongate ray which is connected for about half its length to the dorsal and anal. It is thus seen that the change in number of the caudal rays is opposite to that in the dorsal and anal.

The caudal is the most powerful in the shallow-water forms. The rays are stout in these forms but become very slender and sometimes wavy at the tip in the deep-sea species. The fin is typically truncate or slightly rounded. It is never acuminate as has been described. In *Careproctus cypselurus* and related species it is forked.

Pectoral fin.—The process of specialization in the pectoral, as in the caudal, includes the reduction of the number of rays. The number ranges from 42 in *Liparis* to 21 in *Careproctus* and 14 in *Paraliparis*. In contrast to the trend of modification in the family the change in *Liparis* is to increase the number in the deep-water species. In this genus the pectoral typically has more rays than the anal, while in the other genera it has less.

The outer margin of the pectoral is typically notched. This notch is usually shallow but may extend to the girdle from which the intermediate rays appear to have been lost. The notch is not present in certain species of *Liparis*, *Careproctus*, *Acantholiparis*, and *Paraliparis*.

In Liparis the rays are nearly equally spaced on the girdle, those at the notch being little more widely spaced than those above or below. The separation of these rays reaches its greatest extent in *Paraliparis*. Here also we find a resemblance to the primitive condition, for *P. fimbriatus* has the rays evenly spaced on the girdle.

The lower margin of the lower pectoral lobe in *Liparis* and *Careproctus* consists of a series of rays regularly graduated in length. The number of rays in the lower lobe of the pectoral in *Paraliparis* is reduced and the lobe shaped as though the short anterior rays have been lost. The lower lobe also becomes elongate, the rays sometimes separated to the base and coiled at the tip. The greatest elongation of the pectoral, however, is found in the *Careproctus longifilis* in which species it is fully half the length of the body. In other species of *Careproctus*, as in *C. colletti*, the lower lobe is longer than the head. In some species the length of the lower lobe increases with age.

The upper edge of the pectoral in *Cyclogaster* is on a level with the eye, and the symphysis is on the lower surface of the head behind the eye. In some species of *Paraliparis* the pectoral is lowered and assumes a more horizontal position. The extreme is found in *P. mento*, in which the upper edge ef tho pectoral is below the angle of the mouth and the symphysis is far forward on the chin in front of the eye.

The greatest reduction of the pectoral occurs in *Nectoliparis*, a pelagic genus, in which the two lobes are separated and greatly reduced. It probably has no function except that of balancing. An extremely delicate type of fin not seen by the writer has been

described for *Paraliparis membraneceous*. The rays are very fine and the margin of the fin fringed. In some of the fragile forms the skin connects with the rays some distance from their base.

Disk.—The disk reaches its greatest development among the tide-pool species, where it is of most service to the individual. The average for the number of times the disk is contained in the head in *Liparis* is 2.3 and in *Careproctus* 4.5. In *Careproctus ostentum* the disk is of minute size, yet perfect in structure. In *Elassodiscus* the disk is minute and imperfect, the rays having been lost. This represents the intermediate stage toward the loss of the disk.

The disk is primitively flat. After it becomes functionless and reduced in size it becomes cupped in some forms as in *Careproctus abbreviatus* and the *Careproctus colletti* group. In some of these cupped disks the margin is stiffened and the base set deeper into the body.

The shape of the disk is round or slightly oval and indented on the sides anteriorly. In a number of species, as in the *Careproctus spectrum* group and *Careproctus rhodomelas*, the disk is triangular. This is due to the posterior margin being folded over and the sides, anteriorly, being further indented or folded over. This condition may represent the intermediate stage toward the cupped condition as the completion of the folding over of the margin would produce the cup.

Vent.—One of the most striking modifications of a character in this family is the change of position and direction of the vent. In some species of *Liparis* the vent is nearer the anal fin than the disk. In this genus and *Careproctus* the vent moves forward until it comes to be situated at the posterior margin of the disk. In *Paraliparis* the vent moves into the place once occupied by the disk. In *Nectoliparis* it is on the throat in front of the symphysis of the pectoral. In all the genera except *Nectoliparis* the vent opens downward. In the latter genus the vent opens forward horizontally above a ridge on the throat.

Coloration.—The coloration in a general way is correlated with the environment. The prevailing ground color of the tide-pool species and their nearest relatives of the moderately deep water is brown, olive, and slate; of the species from the region of little or no light translucent, pink and black. The deeper-water forms range from translucent to pure black in the greater depths. Light-colored species exist far into the zone of darkness and certain species are found both in the regions of little light and complete darkness. The black species apparently are never found above 400 fathoms. Some of the tide-pool species, as *Liparis rutteri*, are quite dark, but never black. Light-colored species are taken from a black mud bottom, but how far above the bottom they exist is unknown.

The shallow water forms are typically variegated, being marked with stripes, bars, blotches, and mottlings. These markings vary a great deal in the species, and their significance and importance are unknown, as the variations have not been shown to be correlated with sex, season, or age. They can be used to a limited extent in differentiating species.

The deeper water forms, exclusive of *Liparis*, with but two exceptions, are never variegated. The two exceptions are *Crystallichthys cyclospilus* and *mirabilis*, which have pink blotches on the head and body. A large number of the species from the intermediate depths have the posterior part of the body darker than the anterior part. This suggests that the black coloration appears first in the posterior part of the body and encroaches on the anterior part as the species becomes wholly black. The pigment is not confined to the dermis but frequently occurs in the flesh.

Bars on the fins of species of *Liparis* are very common, but are never found on the fins of the other genera. In some species these bars extend onto the body, but the latter is never strongly barred. Longitudinal stripes are common among the species of *Liparis* but are unknown in the other genera. These stripes are white to gray and sometimes show traces of blue. They may have dark margins and divide posteriorly. Blotches with definite margins are known in but a few species of *Liparis* and *Careproctus*. Indefinite blotches and markings are common in *Liparis*. The giant species of *Liparis* from Japan have a reddish lining to the dermis.

The internal membranes vary from white to black. The peritoneum is primitively white with scattered black dots. It is silvery in many of the intermediate forms and black in the majority of the deep-sea species. The color of the stomach varies as much as that of the peritoneum, but independently, and is not black in so many species. The mouth and gill cavity also vary from white to black. (For a discussion of the relation between coloration and bathymetrical distribution see Burke, 1911.)

Habits.—The primitive species of *Liparis* doubtless inhabited shallow waters, either resting upon the bottom or clinging to the rocks. Many of the present species have the same habits, but a few of the more specialized seem to have acquired free-swimming habits which are of advantage where the food is scarce. *Nectoliparis pelagicus* is the only known pelagic form. It is probable that some species of *Paraliparis* approach this condition.

The eggs of the species are deposited and develop, as far as known, within the general habitat of the species. *Liparis atlanticus* has been described as approaching the shore to deposit its eggs. Such a migration must be very short. The eggs of the deep-sea species must be endemic, as the larvæ are unknown from the plankton. Whether

or not these species approach the shallowest waters of their range to deposit their eggs is unknown. The great vertical range of some of the species may be accounted for in this way. Some of the deep-sea specimens have the body distended with eggs, but they do not furnish sufficient data to indicate that the regular breeding season has been modified. *Careproctus ovigerum* is known from a single specimen, male, and "contained in its mouth, when captured, a spherical mass of eggs apparently of the same species." The specimen was obtained on the 3d of September and the eggs were, "well along in their development, the embryos distinctly visible through the very tough egg membranes." Putman (1873, p. 339) records that the spawning season for *Liparis* is in March. Ehrenbaum (1905) states that *Liparis liparis* spawns from November to February. Smith (1898) describes *Liparis liparis* as full of spawn in December and January. The very extensive dredging in the North Sea has demonstrated that the young of *Liparis montagui* can be obtained in March, or possibly earlier. These facts indicate that the tide-pool species of the family probably spawn during the winter months. Whether this is true of the deep-sea species remains to be investigated.

DISTRIBUTION

The Liparidae is a boreal family. The large majority of the species are found in the North Pacific, North Atlantic, and the Arctic Ocean. A few species have been taken in the great depths of the tropical Pacific and in the shallower cold waters of the Antarctic regions. It is highly probably that the family is represented in the cold depths of the tropical Atlantic and Indian Oceans.

Of all the regions inhabited by these fishes the North Pacific is the most favored. All of the 13 genera and about three-fourths of the species are recorded from this region. Only three of the genera and one-sixth of the species inhabit the North Atlantic. The same three genera and six species are recorded from the Antarctic regions. Seven of the genera are monotypic and when better known their distribution may be extended. Further exploring of the North Atlantic, Antarctic, and greater depths of the tropical regions will probably greatly extend our knowledge of the distribution of these fishes.

Genera.—The genus *Liparis* is represented in the cold shallow waters of the Northern and Southern Hemispheres. The species of this genus are the most numerous in the North Pacific. The genus is limited in its distribution toward the equator by the summer isotherm of about 60° F. The distribution of *Careproctus*, the next largest genus, differing from that of *Liparis* in being absent from the tide pools and, descending to greater depths, is continued into the tropical Pacific. The distribution of *Paraliparis*, the third largest genus, resembles that of *Careproctus*. The remaining ten genera

are either monotypic or composed of a few species and confined to the North Pacific. *Nectoliparis*, consisting of a single pelagic species, ranges widely over the North Pacific. *Polypera* consists of three shallow-water species distributed along the shores of British Columbia, Aleutian, and Kurile Islands. *Temnocora* consists of a single species from Bering Sea. *Crystallichthys* is represented by two species from Bering Sea and Pacific Ocean off Kamchatka. *Crystallias* is a monotypic Japanese genus. *Gyrinichthys* consists of a single Bering Sea species. *Elassodiscus* and *Acantholiparis* are represented by a single species from southeast of Kamchatka. *Rhinoliparis* consists of two species which are distributed from California through Bering Sea to Japan.

Species.—It is generally said that deep-sea fishes are more cosmopolitan in their distribution than shallow-water forms. It is assumed that the environment of the deep sea is quite uniform for each depth and that the species will not be prevented from spreading widely over the bottom of the ocean Many of the species have a great vertical range which would enable them to migrate more readily. A great vertical range suggests that either the environment changes vary gradually with depth or that the species are adapted to a varied environment.

At the present time there appears to be a tendency to believe that deep-sea fishes are not so widely distributed as we have been accustomed to suppose. This view is substantiated by the deep-sea Liparids. These species appear to be little more cosmopolitan than their relatives of the shallow water. In considering this statement it should be borne in mind that we know little about these fishes. The deep-sea species are sluggish and, with but one or a few exceptions, live upon or near to the bottom. The majority of the species are known from but a single locality or region. None are common to the Atlantic and Pacific Oceans or to the north and tropical Pacific. The majority of the American and Japanese species are distinct. Only one species of *Rhinoliparis* and two species of *Careproctus* are found in both the American and Japanese faunas.

The maximum range in latitude for the deep-sea and shallow-water species is about the same. A few species of *Liparis*, *Careproctus*, *Paraliparis*, and *Rhinoliparis* range through about 20° of latitude. The majority of the species have a more restricted range. The distribution of the species of *Liparis*, *Careproctus*, and *Paraliparis* appears to be quite comparable. This similarity may disappear when we come to know the deep-sea species better.

The giant species of the family are confined mainly to the northwest Pacific from Bering Sea through the Okhotsk Sea to northern Japan. This is especially true of the large species of *Liparis*, *Careproctus*, and *Crystallichthys*. The largest species of *Paraliparis*, a

more typical deep-sea genus, are more widely distributed throughout the range of the genus. In addition to the largest species the largest specimens of such species as extend from the Alaskan coast to the Okhotsk Sea are obtained in the latter region. The coldest temperatures for the Pacific Ocean were taken in the southern part of the Okhotsk Sea. A temperature of 30° to 31° F. is common in this region in depths of 100 fathoms. The Arctic current sweeps through into the Japan Sea, marine life is abundant, and with the extreme low temperature the Liparids find a favorable environment for an increase in size. It will be interesting to note whether the largest species of other northern families are found in the Okhotsk Sea and neighboring regions.[5]

Regions.—As the species are quite localized in their distribution we can readily divide the area of the globe occupied by these fishes into regions each of which is distinguished by a group of species not found in the other regions. A few of the species are found in two or three regions, but the majority are known from but a single region. We have found it convenient to designate seven regions, as enumerated below. These regions are not of equal value, but are convenient for illustrating the peculiarities of the distribution of the family.

1. Asiatic region: This embraces the southern coast of Kamchatka and the region southward to Japan. This region may be subdivided, for the Okhotsk Sea and the Japan Sea appear to have a fauna distinct from that of the east coast of the Japanese Islands.

2. Bering Sea region: This region includes Bering Sea and its shores to the northward, not including the Aleutian Islands.

3. Pacific American region: Aleutian Islands and southward to California.

4. Atlantic American region: Coast of New England to Greenland.

5. European region: Coasts of northern Europe.

6. Tropical Pacific region: Depths of the Pacific Ocean between the Tropic of Cancer and the Tropic of Capricorn.

7. Antarctic region: Regions south of the Tropic of Capricorn.

The following table designates the species found in each region:

[5] For a more detailed discussion see under *Liparis* and *Careproctus*.

Name	North Pacific			North Atlantic		Tropical Pacific	Antarctic	Depth (fathoms)
	Asiatic	Bering Sea	American	American	European			
Liparis curilensis	x							0+
Liparis tessellatus	x							61– 150
Liparis frenatus	x							207
Liparis agassizii	x							0+
Liparis ochotensis	x							0– 43
Liparis ingens	x							250
Liparis rhodosoma	x							64– 75
Liparis tanakae	x							(?)
Liparis owstoni	x							(?)
Polypera simushirae	x							0+
Careproctus curilanus	x							229
Careproctus sinensis	x							200
Careproctus segaliensis	x							119
Careproctus homopterus	x							440
Careproctus rhodomelas	x							405– 507
Careproctus bathycoetus	x							1, 800
Careproctus pellucidus	x							129– 182
Careproctus acanthodes	x							318
Careproctus rastrinus	x							73– 119
Careproctus trachysoma	x							318– 429
Careproctus roseofuscus	x							100– 119
Careproctus entomelas	x							114– 428
Careproctus entargyreus	x							35– 66
Careproctus pycnosoma	x							229
Crystallichthys mirabilis	x							58– 100
Crystallias matsushimae	x							70– 200
Paraliparis entochloris	x							100
Paraliparis melanobranchus	x							440
Paraliparis atramentatus	x							649
Elassodiscus tremebundus	x							682
Liparis megacephalus		x						36– 38
Liparis herschelinus		x						0+
Liparis gibbus		x						0– 29
Liparis rufescens		x						48– 69
Liparis bristolense		x						17– 42
Temnocora candida		x						35
Careproctus ectenes		x						270– 350
Crystallichthys cyclospilus		x						29– 52
Careproctus simus		x						350
Careproctus mollis		x						135
Careproctus bowersianus		x						340
Careproctus attenuatus		x						480
Careproctus phasma		x						46– 59
Careproctus furcellus		x						482
Careproctus opsthotremus		x						1, 046
Careproctus ostentum		x						109– 350
Gyrinichthys minytremus		x						350
Paraliparis holomelas		x						406–1, 625
Liparis callyodon	x?	x?	x					0+
Liparis cyclopus	x?	x?	x					0+
Careproctus cypseluras	x	x	x					510– 887
Careproctus colletti	x	x	x					284– 625
Rhinoliparis barbulifer	x	x	x					192– 551

Name	North Pacific			North Atlantic		Tropical Pacific	Antarctic	Depth (fathoms)
	Asiatic	Bering Sea	American	American	European			
Nectoliparis pelagicus	x	x	x	----	----	----	----	300– 609
Careproctus gilberti	----	x?	x	----	----	----	----	102– 482
Paraliparis dactylosus	----	x?	x	----	----	----	----	296– 482
Paraliparis ulochir	----	x?	x	----	----	----	----	406–1, 005
Paraliparis cephalus	----	x	x	----	----	----	----	284– 540
Rhinoliparis attenuatus	----	x	----	----	----	----	----	576
Liparis rutteri	----	----	x	----	----	----	----	0+
Liparis mucosus	----	----	x	----	----	----	----	0+
Liparis grebnitzkii	----	----	x	----	----	----	----	0+
Liparis micraspidophorus	----	----	x	----	----	----	----	0+
Liparis pulchellus	----	x?	x	----	----	----	----	0+
Liparis fucensis	----	----	x	----	----	----	----	0– 212
Liparis dennyi	----	----	x	----	----	----	----	0– 123
Polypera beringianus	----	----	x	----	----	----	----	0+
Polypers greeni	----	----	x	----	----	----	----	0+
Careproctus spectrum	----	----	x	----	----	----	----	92– 110
Careproctus melanurus	----	----	x	----	----	----	----	284– 876
Careproctus abbreviatus	----	----	x	----	----	----	----	625
Careproctus ovigerum	----	----	x	----	----	----	----	1, 588
Acantholiparis opercularis	x?	----	x	----	----	----	----	682–1, 973
Paraliparis deani	----	----	x	----	----	----	----	30– 274
Paraliparis mento	----	----	x	----	----	----	----	685
Paraliparis rosaceus	----	----	x	----	----	----	----	984
Liparis atlanticus	----	----	----	x	----	----	----	0+
Liparis tunicatus	----	----	----	x	----	----	----	0+
Careproctus ranula	----	----	----	x	----	----	----	11? 365
Paraliparis liparina	----	----	----	x	----	----	----	328– 480
Paraliparis garmani	----	----	----	x	----	----	----	300– 540
Paraliparis copei	----	----	----	x	----	----	----	300– 594
Liparis liparis	x?	----	----	x?	x	----	----	0+
Careproctus micropus	----	----	----	x?	x	----	----	55– 976?
Liparis major	----	----	----	x	x	----	----	8– 116?
Liparis montagui	----	----	----	----	x	----	----	0+
Careproctus reinhardi	----	----	----	----	x	----	----	263– 658
Careproctus longipinnis	----	----	----	----	x	----	----	702
Paraliparis membranaceus	----	----	----	----	x	----	----	400
Paraliparis bathybius	----	----	----	----	x	----	----	540– 658
Paraliparis grandiceps	----	----	x	----	----	x	----	1, 588
Paraliparis longifilis	----	----	----	----	----	x	----	1, 823
Paraliparis angustifrons	----	----	----	----	----	x	----	511
Paraliparis fimbriatus	----	----	----	----	----	x	----	1, 772
Paraliparis latifrons	----	----	----	----	----	x	----	1, 793
Paraliparis attenuatus	----	----	----	----	----	x	----	902
Liparis antarctica	----	----	----	----	----	----	x	0+
Liparis steineni	----	----	----	----	----	----	x	0+
Careproctus falklandica	----	----	----	----	----	----	x	8– 82
Careproctus pallidus	----	----	----	----	----	----	x	15
Careproctus georgianus	----	----	----	----	----	----	x	107

Center of dispersal.—The Liparidae has reached its greatest development in the North Pacific. Either the Okhotsk Sea or the Bering Sea appears to be the center from which the present groups have

radiated. Some of the criteria [6] generally used in determining the center of dispersal of a group point to one of these regions and some to the other as the center of dispersal for the family. We shall not attempt to decide between these two regions, but shall simply cite the criteria which point to the northwest Pacific as the center from which the existing groups have dispersed.

1. Most primitive species: This resolves itself into a discussion of the center of dispersal of the most generalized genus *Liparis*. The criteria utilized here, when applied to *Liparis*, indicate the North Pacific as the place of origin of the genus. The primitive species of *Liparis* are in the North Pacific.

2. Greatest differentiation of type: Apparently all of the genera originated in the North Pacific. Only three of the 13 genera are found in any other region. The most generalized species of these three genera exist in the North Pacific. It follows that the genera are most closely related in this region.

3. Giant species: The largest species of all the genera except *Paraliparis* are found in the North Pacific. The specific attain the greatest size about northern Japan. Those species which extend from the American to the Asiatic coast attain the greatest size in the latter region. The fact that the species attain the greatest size in Asiatic waters does not necessarily indicate that this region represents the center of origin. It may simply mean that the conditions here are the most favorable for growth.

4. Dominance or abundance of species: More than half of the species exist in the Bering Sea and southward to Japan. Three-fourths of the species are recorded from the North Pacific.

5. Geographical consideration: We may readily account for the present distribution of the family if we assume that the groups dispersed from the North Pacific. The only barrier that we have to contend with is the equatorial region. This effectively acts as a barrier to the shallow-water species. We have already attempted an explanation of the presence of tide-pool species in the Antarctic region. We have assumed that the species were able to cross the Equator during the glacial period. Whether or not this explanation is satisfactory we must account for the crossing of the equatorial region if we should assign to any other region the center of dispersal for the family.

6. Lines of convergence: In tracing out the lines of convergence for a family we are concerned mainly with the genera. If all the genera have originated in one region we are justified in designating that region as the center of dispersal for the family. It is stated under "Greatest differentiation of type" that all the genera are represented and probably arose in the North Pacific.

[6] See C. C. Adams, 1902, and A. G. Ruthven, 1908.

Bathymetrical distribution.—The Liparidae are found at all depths from the tide pools down to 1,973 fathoms. The species are quite common in the tide pools and down to 800 fathoms. Only 15 of the 114 species are recorded from below 800 fathoms, and 10 below 1,000 fathoms. Perhaps the number of species taken below 1,000 fathoms bears the same relation to the number taken above this level as the number of dredge hauls below 1,000 fathoms bears to the number above. Doubtless the proportionate number of deep-sea forms will be greatly increased.

The three large genera—*Liparis*, *Careproctus*, and *Paraliparis*—while overlapping in their vertical distribution, are confined mainly to different depths. The genus *Liparis* is represented down to 250 fathoms, but it is typically a tide-pool genus. *Careproctus* is typically a genus of the dimly lighted regions. It is represented at all depths from 30 or less to 1,823 fathoms, but half the species are found above and half below the 300-fathom level. For convenience we have designated this level as the center of population for the genus. *Paraliparis* is typically a deep-water genus. It is represented at all depths from 30 to 1,793 fathoms, but the center of population is at about 500 fathoms, or 200 fathoms below that for *Careproctus*. *Polypera* is closely related to *Liparis* and is confined to the same region. *Temnocora*, *Crystallichthys*, *Crystallias*, and *Gyrinichthys* are confined to the same general region as *Careproctus*. *Elassodiscus* is confined to greater depths. *Acantholiparis* and *Rhinoliparis* inhabit the same depths as *Paraliparis*.

The bathymetrical distribution of the species varies widely. The tide-pool species have a vertical distribution of a few feet or fathoms, while the bathybial species range through several hundred fathoms. The maximum vertical distribution for species of several of the genera is as follows:

	Range fathoms	Depth
Liparis dennyi	123	0– 123
Liparis fucensis	213	0– 213
Careproctus cypselurus	377	510– 887
Careproctus mollis	347	135– 482
Careproctus gilberti	380	102– 482
Careproctus colletti	341	284– 625
Careproctus melanurus	592	284– 876
Acantholiparis opercularis	1,291	682–1,973
Paraliparis ulochir	599	406–1,005
Paraliparis holomelas	1,219	406–1,625
Rhinoliparis barbulifer	359	192– 551

The vertical distribution of these species is of interest in connection with the region between 250 and 500 fathoms. Somewhere within this region is supposed to be the indefinite borderland between two differently colored faunas. The red light rays fail to penetrate below 273 fathoms. Whether this level or some other is the most

important in marking the region between two differently colored faunas is discussed under another heading. What we wish to note here is that none of the species are found on both sides of the 250 to 500 fathom region. Certain species extend from far above into this region, others appear to be confined to it, and still others extend from it to the regions far below. The facts seem to indicate that this region marks a distinct change in the environment. It is a dimly lighted region and favorable to the development of the Liparidae.

The region at from 20 to 30 fathoms separates the typical tide-pool species of *Liparis* from the shallow-water species of *Careproctus* and *Paraliparis*. It is doubtful if any of the tide-pool species extend into this region. A number of species of *Liparis* cross it, but none of them are known with certainty to inhabit the tide pools. Three species of *Careproctus*—*C. falklandica*, *C. pallidus*, and *C. ranula*—are reported from depths of less than 20 fathoms. The remaining species of the deeper-water genera extend from 29 fathoms downward.

The following table indicates the bathymetrical distribution of most of the species of Liparidae.

Name	Depth																						
	10	30	50	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800		
Liparis:																							
atlanticus	0+																						
rutteri	0+	16																					
montagui	0+																						
curilensis	0+																						
callyodon	0+																						
grebnitzkii	0+																						
mucosus	0+																						
micraspidophorus	0+																						
liparis	0+																						
cyclopus	0+																						
frenatus	0+					207																	
fucensis	0+					212																	
bristolense		17	42																				
megacephalus			38																				
tunicatus	0+																						
herschelinus	0+																						
agassizii	0+																						
dennyi	0+				123																		
gibbus	0+	29																					
rufescens			48	69																			
ochotensis	0+		43																				
ingens						250																	
rhodosoma				75																			
antarctica	0+																						
steineni	0+																						
tanakae	(?)																						
owstoni	(?)																						
pulchellus	0+																						
tessallatus				61	150																		
major	8				106																		

Polypera:																							
greeni	0+																						
beringianus	0+																						
simushirae	0+																						
Careproctus:																							
pycnosoma						229																	
curilanus						229																	
simus							350																
mollis					135			482															
sinensis						200																	
segaliensis					119																		
bowersianus							340																
falklandica	8			82																			
pallidus		15																					
attenuatus								480															
homopterus								440															
rhodomelas								405	507														
ranula		11?					365																
micropus				55?					540	608			976										
reinhardi						263				658													
georgianus					107																		
phasma			46	59																			
spectrum				92	110																		
melanurus						284						876											
furcellus								482															
cypselurus									510			887											
abbreviatus										625													
bathycoetus																							1, 800
longifilis																							1, 823
ovigerum																				1, 588			
opisthotremus														1, 046									
longipinnis											702												
pellucidus					129																		
acanthodes							318																
rastrinus				73	119																		
trachysoma							318	429															
ostentum					109		350																
gilberti					102			482															
roseofuscus				100	119																		

Name	Depth																				
	10	30	50	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800
Careproctus—Contd.																					
colletti						284				625											
entomelas					144			428													
entargyreus			35	66																	
ectenes						270	350														
Temnocora candida			35																		
Crystallichthys:																					
cyclospilus		29		52																	
mirabilis				58	100																
Crystallias matsushimae				70		200															
Gyrinichthys minytremus							350														
Elassodiscus tremebundus										682											
Acantholiparis opercularis										682											
Paraliparis:																					
dactylosus						276		482													
angustifrons									511												
fimbriatus																				1, 772	
deani			30			270															
entochloris					100																
liparina							328	480													
ulochir								406					1, 005								
melanobranchus								440													
membranaceus								400													
latifrons																				1, 793	
holomelas								406													
bathybius									540	658											
australis							300														

garmani							300		540															
cephalus						284			540															
mento										685														
atramentatus										649														
copei							300		594															
rosaceus													984											
grandiceps																				1, 588				
attenuatus													902											
Rhinoliparis barbulifer					192				551															
Nectoliparis pelagicus							300			609														

TEMPERATURE

The Liparidae thrive best and are most commonly found in temperatures of less than 50° F. The tide-pool species are restricted in their southern distribution by the summer isotherm of 60° F. It is unlikely that any of the species are commonly found in such a high temperature. The species attain the greatest size in the extremely cold water of the northwestern Pacific, where they readily find a temperature of 35° F.

The temperatures inhabited by the bathybial and the shallow-water species are about the same. The maximum and minimum temperatures for the three large genera are as follows: *Liparis*, about 60° F. to 29.7° F.; *Careproctus*, 59° F. to 30° F.; *Paraliparis*, 52.8° F. to 28° F. The deeper-water species of *Liparis* are usually taken from a temperature of less than 45° F. Only one species of *Careproctus* has been reported from a temperature of more than 45° F. The majority of the species are found in a temperature of about 40° F. This is true also of the species of *Paraliparis*.

The regions inhabited by the deeper-water species probably are not affected by the changing seasons and we may reasonably assume that these species remain in a fairly constant temperature. Our records do not indicate the range of temperature that can be endured by the tide-pool species. Some of the deep-water species of *Careproctus* and *Paraliparis* have a range of temperature of 10° F. to 15° F. It is likely that this is exceeded by the tide-pool species.

SUMMARY

It has been pointed out in the general discussion of the modification of structure and the relation between the bathymetrical distribution and the coloration[7] that the species of the deep-sea become highly modified from the tide-pool type. The deep-sea forms have digressed farthest from the primitive stock. It is attempted in the following chart to present in a graphic manner the chief modifications of structure and color as the species became adapted to the deep sea.

It will be seen by an examination of the chart that in the deep-sea species (1) the dorsal and anal rays increase in number; (2) the pectoral and caudal rays decrease in number; (3) the pyloric coeca decrease in number and are lost; (4) the gill slit is usually confined to the region above the base of the pectoral fin; (5) the prickles appear to be more common; (6) the pores are reduced in number; (7) the disk is reduced and lost; (8) the eye increases in size; (9) the connection between the vertical fins is increased; (10) the teeth become simple and restricted in number; (11) the variegated coloration is lost—the partly black forms are the most numerous between 300 and 500 fathoms and the black forms are confined to the regions below 400 fathoms.

[7] Burke, 1911.

Name	Specimens	Depth	Dorsal	Anal	Pectoral	Caudal	Coeca	Gill slit	Prickles	Pores	Disk	Eye	Dorso-caudal connection	Teeth	Color	Peritoneum	Stomach
Liparis:																	
atlanticus	49	0+	34	27	28	-----	30	0	+	2	1.8	5	0.2	Trilobed	Variegated	Pale	Pale.
rutteri	23	0–16	31	25	32	-----	26	0	–	2	1.5	6	.2	do	do	do	Do.
montagui	-----	0+	28	24	(?)	-----	(?)	0	–	2	2	-----	.2	do	do	do	Do.
callyodon	50+	0+	34	26	30	-----	50	0	–	2	2.8	6.3	.2	do	do	do	Do.
grebnitzkii	1	(?)	32	27	29	-----	30	0	–	2	2.2	6.6	.2	do	do	do	Do.
curilensis	32	0+	34	26	29	-----	65	0	–	2	1.9	6.8	.2	do	do	do	Do.
mucosus	11	0+	33	27	30	-----	70	5	+	2	2.4	7.2	.2	do	do	do	Do.
micraspidophorus	4	0+	31	25	31	-----	65	5	+	2	1.7	6.8	.2	do	do	do	Do.
liparis	-----	0–4	34	29	32	12	10	2	–	----	2+	-----	----	do	do	do	Do.
cyclopus	11	0–4	35	30	31	-----	39	5	–	2	2.5	6.2	.2	do	Uniform	do	Do.
frenatus	1	207	37	31	34	-----	21	9	–	2	2.5	4	.2	do	Variegated	do	(?)
fucensis	13	?–212	35	28	41	-----	36	15	–	2	2.6	4.9	.2	do	do	do	(?)
bristolense	12	17–42	38	32	35	-----	18	4	+	2	1.8	4	.4	do	do	do	(?)
megacephalus	3	36–38	43	36	37	10	29	12	+	2	2.	5.8	.4	do	do	do	(?)
tunicatus	31	0+	42	34	38	-----	36	3	–	2	2.2	5.8	.25	do	do	do	(?)
herschelinus	17	0+	44	35	37	-----	18	0–3	–	2	2.2	4.3	.25	do	do	do	(?)
agassizii	32	(?)	42	34	36	10	67	8	–	2	2.2	8	.4	do	do	do	(?)
dennyi	101	?–123	39	32	37	12	23	14	–	----	2.2	7.5	.4	do	do	do	(?)
gibbus	5	?–29	42	34	37	12	36	13	–	2	2.2	4.1	.5	do	do	do	(?)
rufescens	6	-----	40	34	39	10	34	13	–	2	2.3	6.2	.5	do	do	do	(?)
ocholensis	6	?–43	45	36	40	12	30	15	+	2	2.5	8.8	.4	do	do	do	(?)
ingens	1	250	45	37	42	10	37	16	+	2	2.6	10.3	.5	do	do	do	(?)
rhodosoma	5	64–75	45	37	41	-----	37	15	+	2	2.7	7.	.4	do	do	do	(?)
antarctica	1	(?)	28	24	30	-----	10	0	–	2	1.9	4	.4	do	do	do	(?)
steineni	2	0+	44	36	32	10	(?)	(?)	–	2	2.	(?)	(?)	do	do	do	(?)
tanakae	3	(?)	43	35	41	10	62	11	+	2	2.4	9.6	.7	do	do	do	(?)
owstoni	1	(?)	43	35	40	10	50+	10	+	2	2.3	11.5	.6	do	do	do	(?)
pulchellus	49	0+	48	39	37	10	32	0–2	–	2	2.4	5.4	.8	do	do	do	(?)
tessellatus	10	61–150	47	37	35	10	32	16	–	2	3.2	5.8	.8	do	do	do	(?)
ma'or	10	8–106	48	40	35	9	20	9	+	2	2.7	4.2	.4	Trilobed simple	do	Black	Dusky.
Polypera:																	
greeni	4	0–?	40	31	37	-----	326	0–4	–	2	2.8	10	.2	Trilobed	Uniform	Pale	Pale.
beringianus	34	0+	38	31	37	-----	300	0–1	–	2	2.4	6.9	.2	do	do	do	Do.
simushirae	1	0+	44	34	40	-----	300	5	–	2	2.7	7.8	.2	do	do	do	Do.
Careproctus:																	
pycnosoma	1	229	42	37	37	10	14	0	–	2	3	3.3	.3	do	Light	do	Do.
curilanus	2	229	49	43	34	10	6	2	–	2	2.7	3	.4	do	do	do	Do.
simus	-----	350	47	41	33	-----	20	3	–	2	3.8	3	(?)	do	do	do	Do.
mollis	3	135–482	51	47	35	10	8	3	–	(?)	3.5	4.8	.5	do	do	do	Do.
sinensis	1	200	47	47	33	-----	23	0	–	1	3	4.3	.5	do	do	do	Do.
segaliensis	1	119	58	52	24	-----	17	0	–	1	4.2	4	.4	do	do	do	Do.
bowersianus	2	344–426	53	46	37	9	12	1	–	2	5	3.7	.4	do	do	do	Do.

Name	Specimens	Depth	Dorsal	Anal	Pectoral	Caudal	Coeca	Gill slit	Prickles	Pores	Disk	Eye	Dorso-caudal connection	Teeth	Color	Peritoneum	Stomach
Careproctus—Continued.																	
falklandica	2	137–150	(?)	(?)	31	------	(?)	0	—	(?)	2.2	3.5	(?)	Trilobed	Light	Pale	Pale.
paltidus	2	15	(?)	(?)	(?)	------	(?)	0	—	(?)	4	5	(?)	do	do	do	Do.
attenuatus	1	482	48	40	34	------	(?)	0	—	(?)	3.7	3.1	(?)	do	do	Black	Do.
homopterus	1	440	55	49	32	10	(?)	1	—	2	2.7	3.7	.3	do	Light and dusky	Pale	Black.
rhodomelas	2	405	56	48	31	9	12	3	—	2	8.3	4	(?)	do	Dusky and black	Black	Do.
ranula	14	11?–365	53	49	28	------	9	0	—	(?)	3.2	3.4	.5	±	Light	Pale	Pale.
reinhardi	------	263–658	54	46	32	------	(?)	(?)	—	(?)	(?)	(?)	(?)	Simple	do	do	Do.
micropus	2	540–608	37?	36?	(?)	------	(?)	0	—	(?)	4	5	(?)	do	do	do	Do.
georgianus	2	105	52	44	30	------	(?)	0	—	(?)	2	4	.3	do	do	do	Do.
phasma	4	46–59	53	45	34	8	21	0	—	2	3.3	4	.5	do	do	do	Do.
spectrum	4	92–97	52	47	32	10	21	0	—	2	4	3.3	.5	do	do	do	Do.
melanurus	7	284–876	54	47	31	------	20	0	—	2	6.4	3.5	(?)	do	Light and black	Black	Do.
furcellus	2	129	62	57	36	------	45	0	—	2	4	3.7	.4	do	do	do	Do.
cypselurus	4	510–887	59	55	33	6	29	0	—	2	5.3	4	.3	do	Dusky and black	do	Do.
abbreviatus	1	625	39	32	21	------	(?)	0	—	(?)	3.8	3.4	(?)	do	Light	Dusky	Dusky.
bathycoetus	1	1,800	61	55	21	6	9	0	—	(?)	6.9	4.8	.4	do	Black	Black	Do.
longifilis	1	1,823	54	49	21	9	(?)	0	—	(?)	4.5	4.7	.5	do	do	do	(?)
ovigerum	1	1,588	43	34	34	10	19	8	—	(?)	2.9	6	.4	do	Dusky	Dusky	(?)
opisthotremus	1	1,046	46	36	32	------	12	5	—	(?)	3.4	4.7	.4	do	Light	Pale	Pale.
longipinnis	------	702	53	44	31	------	(?)	0	------	------	4.6	5	(?)	do	do	do	Do.
pellucidus	7	129–182	55	49	35	8	18	5	—	2	7	3.4	.4	do	do	do	Dusky.
acanthodes	5	318	52	45	33	------	19	0	+	2	4.8	4	.5	do	do	do	Pale.
rastrinus	3	73–119	59	52	37	8	34	4	+	2	7.8	4.8	.6	do	do	do	Do.
trachysoma	13	318–429	58	53	32	------	20	0–5	+	2–1	7.5	4.3	.5	do	Dusky	do	Dusky.
gilberti	30	102–482	55	46	31	10	10	14	0	2	9	3.5	5	do	Light	do	Do.
ostentum	3	109–350	54	47	32	8	10	14	—	2	9+	3.2	(?)	do	do	do	Black.
roseofuscus	4	110–119	57	48	30	8	22	0	+	2	3.5	4.5	.5	do	do	Black	Pale.
colletti	18	284–629	52	50	28	6	8	0	+	2	3.6	4.3	.2	do	Light and black	do	Do.
entomelas	2	114–428	53	46	28	8	19	0	+	2	3.3	3.5	(?)	do	Light and dusky	do	Do.
entargyreus	2	35–66	57	49	31	8	13	0	+	2	2.8	3.8	(?)	do	Light	Pale	Do.
ectenes	5	270–350	48	44	32	10	0–6	0	+	2	4.6	3.5	.3	Trilobed	Dusky	do	Do.
Temnocora candida	4	135	46	39	35	------	20	0	+	2	3.2	2.8	.4	do	do	do	Do.
Crystallichthys:																	
cyclospilus	12	29–52	49	43	34	10	36	0	—	2	2.3	7	.6	do	Light and blotched	do	Do.
mirabilis	2	58–100	53	44	32	10	40	0	—	2	2.6	5	.5	do	do	do	Do.
Crystalichthys matsushimae	8	70–200	56	53	31	10	71	0	—	1	3	5	.5	do	do	do	Do.
Gyrinichthys minytremus	1	350	(?)	(?)	25	------	14	0	—	1	2.2	3.3	.5	Simple	Light brown	do	Do.
Elassodiscus tremebundus	------	682	65	60	32	------	16	0	—	1	±	3.3	2.5	Trilobed	Light and black	Black	Black.
Paratiparus:																	
dactylosus	4	296–482	64	59	33	------	13	4	—	(?)	—	3.3	.3	do	(?) black	do	Pale.
* *angustifrons*	2	511	57	53	37	------	6	(?)	—	(?)	—	4	(?)	Simple	Dusky	do	Do.

| | | |

Explanation of table.—The list of specimens refers, in nearly all cases, to the specimens examined by the writer. When only a few specimens are recorded for a species they are usually included. The depth refers to the fathoms from which the species have been taken. The depth for the tide-pool species is given as 0+. The gill-slit column refers to the number of pectoral rays in front of which the gill slit extends. The pores refer to the number of pores above the gill slit. The disk refers to the number of times the diameter of the disk is contained in the head. The eye refers to the number of times the diameter of the eye is contained in the head. The dorso-caudal connection refers to the proportional length of the connection between the dorsal and caudal fins and the length of the caudal fin. The variegated coloration means that the body or fins are speckled, barred, or striped; the uniform coloration that the body and fins are not variegated; the light coloration that the body is whitish or pinkish; the light to dusky or black coloration means that the body is whitish or pinkish anteriorly and dusky or black toward the caudal.

PART 2. SYSTEMATIC

Family LIPARIDAE

Family description.—Body cavity short; tail more or less elongate; scales absent or represented by prickles; lateral line reduced to one or two pores above the gill slit; third suborbital styliform, joined to the preopercle as in the Cottoids and related families; teeth tricuspid or simple, in bands or single series, absent from the vomer and palatines; premaxillaries slightly protractile; opercular bones unarmed, the opercular arms sometimes projecting as spines; interopercle ray-like, overlying the branchiostegals; gill opening reduced, varying much in size, never connected across the isthmus; gills 3½, no slit behind the last; pseudobranchiae rudimentary or absent; pyloric coeca numerous to absent; branchiostegals 5 or 6; no air bladder; ventral fins present or absent, when present 1–5, united to form a sucking disk; dorsal fin continuous, sometimes notched, the spines flexible; anal similar to the soft dorsal; pectoral fin broad, in some species divided into an upper and lower lobe; vertebrae 35 to 70. Genera 13; species 114.

The Cyclopteridae and Liparidae may be distinguished as follows:

A [1]. Body cavity elongate, about as long as the caudal region; anal fin with less than 20 rays ..... Cyclopteridae.

A [2]. Body cavity short, shorter than the caudal region; anal fin with more than 20 rays ..... Liparidae.

RELATIONSHIPS OF THE GENERA

LIPARIS

The species of the genus *Liparis* bear the closest resemblance to the Cyclopteridae, and we may reasonably assume that this genus is the most generalized one in the family and the one from which the other genera have directly or indirectly been derived. It is among the tide-pool species of the genus that we find the closest resemblance to the Cyclopteridae. These species have the smallest number of vertebrae and fin rays, the shortest connection between the dorsals, caudal, and anal fin, and the dorsal notched. *L. callyodon* is a good example of this type of species. The characteristics which this species has in common with some or all the other species of the genus and which point to this genus as being the most primitive are the small number of vertebrae, the dorsal notch, the short connection between the vertical fins, the trilobed teeth, the variegated coloration, and the two nostrils.

It is, of course, possible that the most primitive species is best represented by some of the deeper-water species such as *L. megacephalus*. This species has a very wide gill slit. Prickles, presumably a primitive character, are most common among the deeper-water species.

It seems more likely that the genus originated in the tide pools and that representatives descended to greater depths, retaining certain primitive characters as the enlarged gill slit and prickles and becoming modified in other ways, such as the increase in the number of vertebrae and the connection between the vertical fins. The species remaining or originating in the tide pools doubtless retained a larger number of primitive characteristics though becoming modified in some ways. They may have developed more compact, shorter bodies, larger disks, and smaller gill slits and thus became better fitted to withstand the beating of the waves on our rugged coasts. It appears to us that the tide-pool species, such as *L. callyodon* and *L. mucosus*, in their aggregate of characters most nearly resemble the ancestors of the group and the Cyclopteridae.

POLYPERA

The genus *Polypera* differs from *Liparis* solely in the greatly increased number of pyloric coeca. All the species of *Polypera* have more than 200 closely matted pyloric coeca and none of the species of *Liparis* have 100. The pyloric coeca in *Polypera* are in a thick mass and can be distinguished at a glance without counting from the larger coeca of the species of *Liparis*. In the distribution, small gill slit, the notched dorsal, and the short connection between the vertical fins *Polypera* most closely resembles the tide-pool species of *Liparis*. In the increased number of fin rays *Polypera* bears a closer resemblance to the deeper-water species.

CAREPROCTUS

Careproctus and all the remaining genera of the family differ from *Liparis* and *Polypera* in the single nostril and the lack of a variegated coloration. It is not among the deep-water species of *Liparis* but rather among the shallow-water species with the notched dorsal that we shall look for the primitive *Careproctus* stem. In certain characters such as coloration—that is, black peritoneum or silvery abdomen—and reduced posterior nostril *Liparis major* and *Liparis tessellatus* approach the condition found in *Careproctus*. The former species also has some simple teeth. These similarities, however, are only the result of parallelism or convergence. The primitive *Careproctus* arose from an ancestor with a notched dorsal. The dorsal notch is slightly evident in *Careproctus pycnosoma* and *ectenes* and possibly in *Careproctus attenuatus*. Also the genus *Temnocora*, agreeing with *Careproctus* in the single nostril and coloration and probably derived from the same stem, has the dorsal notched. *Careproctus pycnosoma*, in addition to the notched dorsal, appears to be the most primitive member of the genus in the compact body, small number of fin rays, and the strongly developed anterior dorsal rays. In the character of the notched dorsal and the number of fin rays *Careproctus pycnosoma* resembles *Liparis dennyi*. We must, however, if we are to consider *Temnocora* as having been derived from the same stem as *Careproctus*, picture our hypothetical ancestor as having a much deeper dorsal notch than *Liparis dennyi*.

The species of the genus *Careproctus* vary widely in a number of characters, and we may well inquire if the genus is not polyphyletic. We have seen that *Liparis major* and *Liparis tessellatus* approach *Careproctus* in the reduced posterior nostril and the coloration. With the closure of the posterior nostril and the loss of the variegated coloration these species would resemble typical species of *Careproctus*. There is hardly sufficient evidence to cause us to more than briefly consider the possibility of *Careproctus* being polyphyletic.

TEMNOCORA

Temnocora difiers from *Careproctus* in the slitlike pupil and the more prominent dorsal notch. It agrees with *Careproctus* in the single nostril and the coloration and probably has been derived from the same stem. *Temnocora candida* has no near relatives among the known species of *Careproctus*. In the shape of the body and the coloration it resembles *Careproctus phasma* and related species. In the character of the pupil the species bears a resemblance to *Crystallichthys* and *Crystallias*. This resemblance may indicate genetic relationships or only convergence.

CRYSTALLICHTHYS

Crystallichthys differs from *Careproctus* in the blotched coloration and the peculiar slitlike and notched pupil. It apparently has been derived from the *Careproctus* stem, possibly after the loss of the dorsal notch.

CRYSTALLIAS

Crystallias has apparently been derived from a *Crystallichthys mirabilis*-like ancestor. It resembles this species in coloration, shape of head and body and the folds on the snout. It differs from *C. mirabilis* in the presence of barbels on the snout and the absence of the notch in the pupil or the presence of a flap on the upper edge of the iris. Rudiments of barbels are possibly present in *Crystallichthys mirabilis* in the folds of skin between the pores on the snout.

GYRINICHTHYS

The genus *Gyrinichthys* differs from *Careproctus* solely in the greatly reduced gill slit. It apparently has been derived from the specialized simple toothed species of *Careproctus*. With the discovery of a species of *Careproctus* having the gill slit but little smaller than in some of the known species the genus *Gyrinichthys* will have to be reduced to synonomy.

ELASSODISCUS

Elassodiscus differs from *Careproctus* in the rudimentary condition of the ventral disk, the rays being absent. The nearest approach to this condition is found in *Careproctus ostentum*, in which the disk is minute but perfect in structure. *Elassodiscus*, however, has been derived from a different line of development than *C. ostentum* for the teeth are strongly trilobed in the former and simple in the latter and related species. The species of *Careproctus* with trilobed teeth all have the disk well developed. We must then conclude that there is a considerable gap between *Elassodiscus* and the generalized species of *Careproctus* with trilobed teeth from which it must have developed.

PARALIPARIS

Paraliparis apparently has been derived from the *Elassodiscus* stem. The only difference between the genera is the absence of the rudimentary disk in *Paraliparis*. The genus could not have arisen from an *ostentum*-like ancestor, for the most primitive species, *P. dactylosus*, has trilobed teeth. It is possible that the *Careproctus ostentum* branch gave rise to species without disks and that *Paraliparis* is diphyletic.

RHINOLIPARIS

Rhinoliparis differs from *Paraliparis* solely in the presence of barbels on the snout. The presence of lobed teeth in *Rhinoliparis barbulifer* suggests that the genus arose from the primitive *Paraliparis* stem.

ACANTHOLIPARIS

Acantholiparis differs widely from any known genus, and its origin is in doubt. It differs from *Paraliparis* in the absence of pyloric coeca and the projection of the opercular arms from the side of the head as spines. The only character which *Acantholiparis* shares with *Paraliparis* and not with *Careproctus* is the loss of the disk. It appears most likely that *Acantholiparis* has been derived from the *Paraliparis* stem.

NECTOLIPARIS[8]

Nectoliparis differs widely from all the other genera in having only five branchiostegals, the gill slit restricted to the front of the pectoral, and the vent situated on the throat and opening forward.[9] The absence of the disk suggests that the genus may have been derived from *Paraliparis*. The single series of teeth in *N. pelagicus* resembles the condition found in *P. copei* and related species.

In this discussion it has been assumed that the trilobed teeth and dorsal notch wherever found are primitive and not secondarily acquired and that the loss of the posterior nostril has taken place along only one line of development and indicates genetic relationships.

KEY TO GENERA

A[1]. Nostril double; pseudobranchiae present; pectoral typically with more rays than anal.
  B[1]. Pyloric coeca less than 150, probably always less than 100----Liparis.
  B[2]. Pyloric coeca more than 150, probably always more than 200---Polypera.
A[2]. Nostril single; pseudobranchiae apparently always absent; coloration not variegated; pectoral typically with less rays than anal.
  C[1]. Dorsal notched.
    D[1]. Coeca present----Temnocora.
  C[2]. Dorsal unnotched, or if notched the pupil round.
    E[1]. Disk present.
      F[1]. Disk perfect.
        G[1]. Snout without barbels.
          H[1]. Gill slit well developed.
            J[1]. Pupil round or but slightly oval; no color blotches on the body----Careproctus.
            J[2]. Pupil reduced to a horizontal slit; body with large roundish or irregular blotches----Crystallichthys.
          H[2]. Gill slit reduced to a pore----Gyrinichthys.
        G[2]. Barbels present on the snout----Crystallias.
      F[2]. Disk rudimentary, the rays absent----Elassodiscus.

[8] In a recent article Johnsen (1919) questions the validity of this genus. We are unable to agree with his opinion.

[9] A new genus, *Lipariscus*, has been described since the above was written. Its relationships with *Nectoliparis* will be found discussed in the appendix on page 194.

E². Disk absent.
K¹. Branchiostegals 6; vent vertical; gill slit at least partly above the pectoral fin.
L¹. Opercular arms not projecting as spines; coeca present.
M¹. Snout without barbels.....Paraliparis.
M². Snout with barbels.....Rhinoliparis.
L². Opercular arms projecting as spines; coeca absent. Acantholiparis.
K². Branchiostegals 5.
O¹. Vent forward on throat, opening forward; gill slit restricted to the front of the pectoral fin; pectoral lobes separate....Nectoliparis.
O². Vent posterior in position, between pectoral lobes; gill slit above pectoral; pectoral lobes connected by widely spaced rays.Lipariscus.

Genus LIPARIS Artedi

Liparis Artedi, 1738, Genera, 117.—Scopoli, 1777, Introd. Nat. Hist., p. 453.—And of various writers.
Cyclogaster Gronow, 1763, Zooph.—Girard, 1858, Pac. R. R. Rept., vol. 10, Fishes, p. 131; Int. Comm. zool. Nomen., Op. 20.—Lonnberg, 1899, Notes Swed. Arct. Exp.—Ehrenbaum, 1902.—Gilbert and Burke, 1912, *a*, *b*.—Burke, 1911, 1912, *a*, *b*.
Actinochir Gill, 1864, Proc. Acad. Nat. Sci. Phila., vol. 16, p. 193 (*major*).
Neoliparis Steindachner, 1875, Ich. Beitr., vol. 111, p. 54 (*mucosus*).
Careliparis Garman, 1892, Mem. Mus. Comp. Zoöl., vol. 14, No. 2.
Lyoliparis Jordan and Evermann, 1896, Rept. U. S. Fish Comm., 1895, p. 451 (*pulchellus*).

Disk present; nostrils 2; teeth trilobed; suprabranchial pores 2; anterior dorsal rays spinous; pyloric coeca present, less than 150; pseudobranchiae present; branchiostegals 6.

MODIFICATION OF CHARACTERS

Body.—The typical tide-pool species have a short, stout body which is rather wide and depressed anteriorly. The shape of the body in some of the deeper water species differs from that of the tide-pool species. In *Liparis owstoni* the body is greatly compressed and deepened, in *Liparis rhodosoma* more elongate and slender, and in *Liparis megacephalus* and *major* shortened, deepened, and compressed. In a few exceptional cases the shape of the body may help to distinguish the species.

The body is typically firm in this genus. In some of the species, mainly the deeper-water forms, such as *Liparis cyclopus*, *owstoni*, and *rhodosoma*, the skin and flesh are somewhat softer and approach the condition found in *Careproctus*.

Nostrils.—Both nostrils are always present in *Liparis*. In *Liparis major* and *tessellatus* the posterior nostril is reduced in diameter and

forecasts the closing of the opening. The posterior nostril opens above the anterior part of the eye. The tube never projects as high above the surface of the head as the anterior nostril tube. In a few species, as in *Liparis owstoni*, the rim of the tube is distinctly raised above the surface of the head. In *Liparis rutteri*, *callyodon*, *dennyi*, and several other species the rim anteriorly is raised into a fingerlike projection. The anterior nostril tube always projects above the surface of the head. The length of the tube varies somewhat, but it is doubtful if this variation can be utilized to any extent in separating species. Some specimens of *Liparis rutteri* and *major* have a very short tube, there being a variation within the species. In *Liparis tessellatus* the anterior tube projects hardly more than the posterior tube in some of the other species.

Eye.—The proportionate size of the eye varies considerably throughout the genus and is of value in distinguishing species. As the size of the eyes varies with age too much stress must not be placed upon a difference in the sizes of the eyes of two specimens unless these are of the same length. The eye varies in the different species from 4 to 10.5 in the length of the head. In some species, such as *Liparis megacephalus* and *agassizii*, the lower half of the eye is silvery. The silvery pigment frequently disappears in preserved specimens.

Pores.—The pore formula for the genus is 2 on the snout, 6 in the maxillary series, 7 in the mandibular series, and 2 above the gill slit. These numbers are constant for all the specimens examined by the writer. The position of the snout pores in relation to the anterior nostril, the maxillary pores in relation to the eye, and the suprabranchial pores in relation to the gill slit and to each other varies, but these variations appear to be of little practical value in separating closely related species.

In many of the species rudimentary pores can be seen in the region of the lateral line and scattered in the region of the gill slit and nape. These are always closed, the lips can sometimes be seen at the tips of small papillae. The papillae are always white and frequently surrounded by a dark ring. When the skin is transparent and lax it is difficult to detect these pores. They have not been demonstrated in all the species. Their taxonomic importance has yet to be investigated.

Teeth.—All the species of *Liparis* have trilobed teeth. In *Liparis major* and *ingens* the inner teeth are simple or weakly trilobed. The teeth are arranged in oblique rows and form broad bands. There are usually more oblique rows in the upper jaw. The oblique rows are usually distinct though in some of the giant species they become irregular and obscure. In some of the species the number of oblique rows appears to be the same in the young and adults and in other species different.

The taxonomic value of the number of teeth has yet to be thoroughly demonstrated. The writer counted the rows of teeth in the majority of the species but neglected to investigate the amount of variation within a species. It is possible that certain species may be separated by the number of oblique rows of teeth.

Gill slit.—The size and position of the gill slit are of great taxonomic value and are utilized for distinguishing the species in both the keys and descriptions. The gill slit, when small, is restricted to the side of the head above the base of the pectoral fin. When large, the gill slit extends down in front of the base of the pectoral but is never confined to this region. The gill slit varies in position from above the pectoral to down in front of 16 or more pectoral rays. The size of the gill slit varies little with age and within a species never varies more than in front of four or five pectoral rays. As the gill slit is constant in size and position for each species and has become modified in a heterogenetic manner in the different branches of the genus, it can be utilized to great advantage in distinguishing species.

As we should expect, we find certain species, such as *Liparis herschelinus*, in which some specimens will have the gill slit above the pectoral fin while others will have it extending down in front of the upper pectoral rays, the normal condition being either above the fin or extending down in front of two or three rays. In some specimens the gill slit on one side will be above the fin and on the other side extending down on front of the upper ray. Such specimens are difficult to identify by this character.

The gill slit is typically above the pectoral fin in the tide-pool species. The deeper water species typically have a larger gill slit.

Dorsal fin.—The dorsal fin presents three important specific characters, the number of rays, presence or absence of the notch, and the extent of the connection with the caudal fin. The number of rays varies from 28 to 48. The number never varies more than four or five within a species. The dorsal notch is more characteristic of the shallow water than of the deep water species. The dorsal may be free from the caudal or connected with three-fourths the length of the latter.

The dorsal notch has formerly been used to separate the genus *Neoliparis* from *Liparis*. The notch, however, is not of specific value in *Liparis dennyi* and *bristolense* and other species. The dorsal notch is present in some specimens and absent from others. The anterior dorsal rays in the specimen from which the notch is absent do not increase regularly in length but are about equal and form a horizontal outline.

The dorsal notch apparently bears no relation to the unsegmented rays. The number of unsegmented rays also appears to be independent of age. The number of rays in front of the notch is seldom

more than six. The following table presents the facts from which the above conclusions have been drawn.

Name	Length in mm.	Unsegmented dorsal rays	Unsegmented anal rays
callydon	53	15	3
Do	40	14	2
Do	78	14	3
Do	95	14	3
Do	42	14	2
Do	55	15	4
Do	48	12	(?)
tunicatus	60	12	3
Do	100	11	1
herschelinus	(?)	10	2
atlanticus	70	[1] 7	(?)
Do	65	[2] 6	(?)
Do	95	[2] 7	1
rutteri	(?)	10	2
mucosus	82	15	4
dennyi	65	11	1
greeni	125	16	2
Do	230	16	3
agassizii	92	9	2
Do	125	7	1
Do	165	8	2
major	105	15	5

[1] 5 in first dorsal. [2] 4 in first dorsal.

The rays of the first dorsal differ from those of the second dorsal not in being unsegmented but in being undivided and therefore consisting of a single rod. The writer has not demonstrated that the notch in all those species in which it is present marks the division between these two types of rays. In the species without the dorsal notch the anterior rays which represent the first dorsal are undivided. This statement is based on an examination of *L. dennyi*, *tunicatus*, and *tanakae*.

The position of the origin of the dorsal varies somewhat but can not be utilized to any extent in distinguishing species.

In two species, *Liparis rutteri* and *atlanticus*, the first dorsal rays are sometimes greatly elongated. The elevated dorsal is supposed to be found only on the males and during the breeding season.

The dorsal connection with the caudal is constant within a species. The connection is typically shortest among the tide-pool series. In some of these species the dorsal appears to be free from the caudal. In nearly all such species the dorsal membrane connects with the skin-covered base of the caudal. The connection between dorsal and caudal is typically greatest among the deep-water forms. In *Liparis pulchellus*, however, a shallow water species, the dorsal connects with fully three fourths of the caudal. Of the deeper-

water species *Liparis owstoni* and *tessellatus* have the dorsal connected to fully three-fourths of the caudal. In some of the species the last dorsal ray is shortened, this forming a notch between dorsal and caudal. This notch appears to be of little taxonomic value because of great variability. It may be constant for some species but the writer never found it so. When the notch is present or when the dorsal connection to the caudal is short the outline of the posterior part of the fin descends abruptly to the caudal. In *Liparis pulchellus* and *tessellatus*, in which the dorsal is broadly connected to the caudal, the outline of the dorsal slopes gradually and indistinctly merges into the caudal outline.

Anal fin.—The important characteristics of the anal fin are the number of rays and the extent of the connection with the caudal fin. The number of rays varies from about 24 to 40. The specific variation is seldom more than four—that is, two on each side of the average number. The connection with the caudal is, in practically all of the species, slightly greater than the dorsal connection with the caudal. The anterior anal rays, in some species if not in all, resemble the anterior dorsal rays in being unsegmented but differ in being split to the tips.

Caudal fin.—The caudal fin is always strong and broad. It varies little among the various species, either in shape or number of rays, and does not present characters which can be frequently utilized in distinguishing species. The average number of rays forming the main body of the fin is 10 or 12. There appears to be little variation within a species. There are in many species short rays on each side of the base which appear only when the fin is dissected. These short rays appear to be more numerous in such species as *Liparis callyodon*, in which the caudal is practically free from the dorsal and anal. There may be as many as 8 or 10 rudimentary rays, which bring the total number of caudal rays up to 18 or 20. The discrepancies between the descriptions of the caudal of a species are probably due to the short rays which may or may not have escaped observation. In the specific descriptions in this work the number of caudal rays given refer to the full-length rays.

Pectoral fin.—The pectoral fin presents important characters. The number of rays is of the most importance. The absence of the pectoral notch separates a few of the species from all the rest. The length of the lower pectoral lobe varies and can be utilized to a slight extent in separating species.

The number of pectoral rays ranges from about 28 to 41. The specific variation is about four. In nearly all of the species the number of pectoral rays is less than the number of dorsal rays and greater than the number of anal rays. In one species, *Liparis fucensis*, the pectoral has more rays than the dorsal. The pectoral of

Liparis pulchellus, *tessellatus*, and *steineni* has an equal or smaller number of rays than the anal. *Liparis major* has a smaller number of pectoral than anal rays and in this character, as well as the simple teeth, reduced posterior nostril, and black peritoneum, approaches the condition found in *Careproctus*.

The majority of the species have the pectoral notched. This is caused by the rays near the middle of the fin being shorter than some of those below. In *Liparis owstoni*, *tanakae*, and possibly *antarctica* and *steineni* these rays are not shorter than those below and the margin of the fin is not notched. Whether or not this is true of the pectoral in the young is unknown. There is some evidence that the young of *Liparis tanakae* have a lightly notched pectoral.

In *Liparis* the lower pectoral lobe is never elongate. The length varies among the species and with age. In some species it does not extend beyond the disk and in others reaches nearly to the anal. The variation in length of either the upper or lower lobe between related species is so slight as to be of little taxonomic value. In all the species the rays of the lower lobe are somewhat thickened, partly free, and graduated in length.

The upper edge of the pectoral fin is at about the same level on the body in all the species.

Disk.—The size of the disk is one of the important specific characters. The diameter of the disk is contained from 1.5 to 3.2 times in the head. The proportional size of the disk varies with age, being larger in the young individuals.

The distance from the tip of the lower jaw to the disk varies with the length of the head and the size and position of the disk. It may be greater or less than the diameter of the disk. The number of times it is contained in the head varies with the species and, in a few cases, serves to distinguish them.

The width of the flap varies slightly, but not enough to be of specific value. It may be greater or less than the diameter of the center of the disk. The disk is round or slightly oval, but never triangular as in some species of *Careproctus*. The long diameter of the disk is usually parallel with the body. The margin of the disk is indented at the sides anteriorly.

Vent.—The position of the vent varies but little among the different species. It is close to the disk, but usually about midway between disk and the origin of the anal fin. The distance between disk and vent varies from 1.6 to 4.8 in the head. The amount of variation within a species may be due to age.

Pseudobranchiae.—The writer investigated the pseudobranchiae solely for the purpose of demonstrating their presence in the species. It was noted however that there were usually about five filaments. Pseudobranchiae were seen on the following species: *gibbus*, *cyclopus*, *agassizii*, *fucensis*, *tunicatus*, *herschelinus*, *tanakae*, and *pulchellus*.

Pyloric coeca.—The number of pyloric coeca varies from about 10 to 90. There is considerable variation in the number of coeca in some of the species. The variation in *L. callyodon* is from 42 to 64 and in *L. agassizii* from about 60 to 90. The evidence at hand indicates that when the average number of coeca is 40 or 50 the amount of variation will be 10 or more and possibly as high as 30. In spite of this variation, the number of coeca constitutes an important specific character. When more thoroughly investigated it will doubtless be found that the average number of coeca can be used to considerable advantage in designating species.

The length of the coeca varies considerably, but this character has not been sufficiently studied by the writer to warrant any conclusions as to its value.

In this genus the coeca are always on the right side and more easily examined through an incision on this side.

Prickles.—In 1904 Jordan and Synder proposed a new genus, *Trismegistus*, based on the presence of "thumb-tack" prickles. This is good evidence that these structures had escaped serious consideration previous to this time. They had been noted and figured, however by Lütken (1886) and Garman (1892). Jordan and Evermann, 1898 (p. 2107) describe the color of *L. atlanticus* as, "with small scattered light or bluish dots over the body." These dots are the bases of the prickles which they failed to notice. The writer has described their presence in a number of the genera. The species of *Liparis* upon which the writer has noticed prickles are *L. atlanticus, mucosus, micraspidophorus, bristolense, ochotensis, ingens, megacephalus, rhodosoma, tanakae,* and *owstoni.* Lütken records them in *L. major.*

The significance of these prickles is unknown. In some species, as *L. atlanticus,* the prickles appear to be found only on the male and during the breeding season. They are not solely a male character, however, for the writer has examined them from the bodies of female specimens of *L. megacephalus, bristolense,* and *ochotensis.* Schmidt, 1904 (p. 191), records what he considers to be a specimen of *L. owstoni* (probably *tanakae*) as a female and "covered with thumb-tacklike plates which make it rough." All the 12 specimens of *L. bristolense* have thumb-tack prickles. Some species, such as *L. callyodon,* never have prickles. It is possible that in some species prickles are always present on both sexes, in others occasionally present on both sexes, in others occasionally, seasonally, or always present on the male. Other possibilities suggest themselves but the above-mentioned cover the field of probability.

The prickles are usually or always absent from the lower surfaces of the body. They may be confined to a limited area, such as the nape, or distributed over the upper and latral surfaces of the head and body

and onto the fins. It is not known that in any species the prickles are localized or restricted to a definite region of the body.

Coloration.—The species of *Liparis* are all dull colored. The coloration consists of bars, lines, blotches, and mottlings of brown, olive, slate, and white. In the majority of the species the fins are speckled or faintly barred with brown. The coloration of some of the deeper-water forms has been slightly modified. The varigated coloration is retained but in addition, as in *L. rhodosoma* and *L. tessellatus*, the body becomes somewhat pinkish and translucent. In *L. tessellatus* the peritoneum becomes silvery and in *L. major* black. In *L. owstoni* and *L. tanakae* the lining of the dermis is reddish.

The coloration is not always uniform for a species. Some of the species exhibit a wide range of color variation. Certain specimens of *L. pulchellus*, *dennyi*, *agassizii*, and other species have longitudinal, wavy, or straight lines on the head and body. One of the specimens of *L. rhodosoma* and several of *L. dennyi* have irregular oblong pink or whitish blotches on the head and body. These may represent modified stripes. These peculiar types of coloration have not been associated with sex or age. Many of the species exhibit distinct color markings by which they can be easily identified. In some of the species certain specimens can be identified by their coloration while the remaining specimens differently colored have to be identified by other means.

The membranes of the mouth, gill cavity, and peritoneum are usually a dull white. The peritoneum is frequently sparsely dotted with black or brown. In *L. dennyi* the peritoneum is undotted. In *L. tessellatus* it is silvery. In *L. major* it is black or heavily pigmented with black.

Habits.—The tide-pool species remain stationary on the bottom or cling to the rocks and seaweed by means of the disk. When attached to seaweed they may be carried some distance from the shore. Some of the deeper-water forms, judging from the shape and texture of the body may move about more than the tide-pool species. It is unlikely that any of the species swim continuously and at a considerable distance from the bottom.

Food.—The food of these species consists mainly of Isopods and Copepods. Small fishes are sometime taken.

Summary.—In order to present a guide to the study of the specific characters of these fishes the following outlines are given. The first list suggests the characters which the writer has found to be the most valuable in detecting and separating species. The second list involves those characters which are of less value or have not been adequately studied.

LIST 1

Body	Shape.
	Depth.
	Length.
	Texture.
Head	Length.
	Depth.
	Width.
Nostril	Flap.
Eye	Size.
Gill slit	In relation to pectoral
Dorsal	Number of rays.
	Notch.
	Elevated rays.
	Connection to caudal.
Anal	Number of rays.
	Connection to caudal.
Pectoral	Number of rays.
	Notch.
	Length of lower lobe.
Disk	Size.
	Snout to disk.
Coeca	Number.
Color	Body.
	Peritoneum.
Distribution.	

LIST 2

Head	Maxillary.
Nostril	Length of tube.
Eye	Color.
Pores	Position of.
	Rudimentary.
Teeth	Number of rows.
Dorsal	Origin of.
	Segmentation of rays.
Caudal	Number of rays.
	Rudimentary rays.
Prickles.	
Color	Stripes.
Pyloric coeca	Length.

DISTRIBUTION

The genus *Liparis* is confined to the shallow cold water of the Northern and Southern Hemispheres. The majority of the known species are from northern regions. Up to the present time only two species are known from Antarctic regions. Many of the species are found in the tide pools. At least 21 of the 30 species have been taken in less than 10 fathoms. Only 5 species have been taken from depths below 100 fathoms and 3 from below 200 fathoms. The greatest depth at which a specimen has been taken is 250 fathoms. We may provisionally place the lower margin of the bathymetric distribution of the genus at about this level.

Limits of distribution.—The tide-pool species extend farthest south on the Pacific coast of America. Species of *Liparis mucosus* are infrequently taken in the deep tide pools at Pacific Grove, Calif., or just north of parallel 36° N. On the Asiatic coast specimens of *Liparis agassizii* have been taken at Mizako, north of parallel 39° N.[10] The species is not a typical tide-pool species, and the specimens recorded may have all been taken with seines below the tide pools. The writer did considerable collecting in Hakodate Harbor but obtained no specimens of *Liparis* from the tide pools. The Japanese

[10] Smith and Pope (1906) record specimens of *Liparis agassizii* obtained from the museum at the Fishery Experiment Station, Shiogama, Matsushima Bay, Japan.

were observed to catch specimens of *Liparis agassizii* with hook and line in shallow water. The southernmost locality in Asiatic water from which typical tide-pool species of *Liparis* have been obtained is Simushir Island, at about latitude 45° N. It is very likely that tide-pool species exist on the northern coast of Hokkaido. The tide-pool species apparently extend 3 or more degrees of latitude farther south on the American than on the Asiatic side of the Pacific.

The deeper-water species have been recorded farthest south in Asiatic waters. On the American coast none of the deeper-water species are recorded as far south as the tide-pools species. The reverse is true of the Asiatic species. The *Albatross* obtained specimen of *Liparis tessellatus* at Station 4867, Japan Sea, 36° 31′ N., depth 150 fathoms, temperature 33.4° F. This is at about the same latitude as Pacific Grove and represents the southernmost distribution of the genus in the Northern Hemisphere.[11]

We may account for the difference in distribution between the American and Asiatic species as due to the difference in temperature. This in turn is governed by the warm Japan current from the south and the cold Arctic current from Bering Sea. The warm current flowing northward meets the cold current in the latitude of Hakodate, 42° N., and is deflected to the eastward. It is cooled by the time it reaches the American coast and flows southward at a lower temperature. The surface temperature of the Japanese waters, due to the Japan current, is higher than the temperature of the surface of the California coast. This may account for the difference in distribution of the tide-pool species.

The cold Arctic current from Bering Sea cools the northern coast of Hokkaido and makes veritable ice chests of the bottom of the Okhotsk and Japan Seas. The deeper waters of Japan are cooler than the waters of the same depth and latitude on the American coast. The Japanese specimens so far collected are from colder waters than the American specimens. The Asiatic species inhabit the same depths as the American species but on account of the difference in temperature are enabled to find a favorable environment farther south.

The Okhotsk and Japan Seas offer a favorable environment for the development of Liparids and when further explored will doubtless be found to contain many more species. A temperature record of 29.7° F., the lowest for the Pacific Ocean, was taken in the southern part of the Okhotsk Sea at a depth of 64 fathoms. In the Japan Sea the temperature at a depth of 150 fathoms is less than 34° F. and at 200 fathoms less than 33° F. Species of *Liparis* can descend to this depth and

[11] Schmidt (1904) records a large specimen of "*Liparis owstoni*" from the Nagasaki fish market. Where this specimen was collected is unknown.

find a very favorable environment. In fact a temperature of 40° F. is favorable to most of the species.

The favorable environment offered by the cold waters of this region may account for the gigantic size attained by some of the species. The four largest species of the genus, ranging in length from 430 to 485 mm. are found in Japanese waters. One of these comes from a temperature of 32.7° F., another from 33.9° F. The other two specimens lack records. The largest species from the American coast is *L. greeni* and reaches a length of 244 mm.

The tide-pool species of the Atlantic coast of America extend as far south as the coast of Massachusetts or possibly of Connecticut. This is about the same latitude as the north of Hokkaido, their southernmost distribution on the Asiatic coast. In both regions a northward-moving warm current raises the temperature of the surface waters and produces an unfavorable environment for these Arctic fishes. The Gulf Stream is deflected to the northeast off Nova Scotia and warms the shores of Europe to such an extent that these fishes are restricted still further to the northward. Only 5 species are known from the North Atlantic, in contrast to the 14 American species and 10 Asiatic species in the North Pacific.

The tide-pool species are, in a general way, limited in the southern distribution by the summer isotherm of 60° F. The deeper-water forms are not, or but rarely, found in a bottom temperature of 50° F. and are usually found in less than 45° F. This temperature, with the factors governing the vertical distribution, marks the southern limit for the distribution of the deep-water species of the genus.

Two species of *Liparis* are known from the Southern Hemisphere. Both are from the cold waters of South America. *Liparis antarctia* is from Eden Harbor and *Liparis steineni* from South Georgia. They inhabit an environment similar to that of their northern relatives.

The distribution of the genus in the Northern and Southern Hemispheres bears the same relation to the marine regions of Gill (1875). In the north the genus is distributed from near the middle of the Pararctalia northward and in the south from near the middle of the Notalia southward.

Asiatic and American species.—The Asiatic and American species are distinct. It can not be said with certainty that any species is found on both sides of the deep Kamchatka Channel. Three species are doubtfully recorded from both sides of this channel. Two immature and poorly preserved specimens from Plover Bay, Siberia, are listed as *L. callyodon*. Two immature specimens from Petropavlovsk are recorded as *L. cyclopus*. *L. gibbus* is recorded from both shores of Bering Sea. Of these species *L. callyodon* is distinctly a tide-pool species. The other two descend to deeper water. It appears that there

has been little or no migration across the Kamchatka Channel in recent times. The deep water acts as a barrier to the adults, and the eggs are probably endemic or fastened to the seaweed or rocks.

It is interesting to note that the majority of the American species inhabit the tide pools and that a large majority of the Asiatic species come from greater depths. This may be explained as only apparent because of the lack of a thorough exploration of the Siberian coast, or, that failing, to the longer stretch of favorable coast line reaching from central California to the Aleutian Islands and northern Alaska.

Regions.—We may conveniently divide the species of this genus into four groups which inhabit different geographical regions. These regions may be termed Asiatic, Pacific American, North Atlantic, and South American. The species of each region, with a few possible exceptions, are distinct. The Asiatic region contains 10, the Pacific American 14, the North Atlantic 5, and the South American 2 species.

The Pacific American region can be divided into two sub regions—(1) northern California to the Aleutian Islands, (2) coast of Alaska north of the peninsula to the Arctic Ocean. The first of these regions conforms with the first three regions given by Evermann and Goldsborough (1907–222), and the second in a general way with the fourth and fifth. Certain species extend nearly throughout the first subregion or practically 20° of latitude. *L. mucosus* inhabits the shore line from Pacific Grove to Kodiak Island; *L. pulchellus* from San Francisco Bay to Bristol Bay; *L. callyodon*, *P. beringianus*, and *P. greeni* from the northern coast of Washington to Bering Island. None of the Asiatic or North Atlantic species are known to range through so many degrees of latitude.

The Alaska Peninsula apparently serves as a barrier to the deeper-water species. None of these are known from both sides of this barrier.

The deeper-water species are not known to have a greater range than the tide-pool species. *Liparis fucensis* and *L. dennyi* have the greatest range and extent from the coast of Washington to the Gulf of Alaska.

Distribution of closely related species.—Our knowledge of the relationships of the species of *Liparis* is too incomplete to draw any final conclusions concerning the distribution of closely related species, but what evidence there is is of interest to anyone testing the law stated by Jordan as, "given any species in any region, the nearest related species is not likely to be found in the same nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort." The genus *Liparis* can be divided into groups of closely related species and species which are isolated in their relationships. The groups of related species and their distribution are as follows:

callyodon—Washington to Bering Island.
curilensis—Simushir Island, Kurile Group.
mucosus—Pacific Grove to Kodiak Island.
micraspidophorus—Agattu and Bering Island.
greeni—Washington to Bering Island. Not in tide pools.
beringianus—Washington to Bering Island. Tide pools.
simushirae—Simushir Island. Tide pools.
dennyi—Washington to Gulf of Alaska.
gibba—Bering Sea.
cyclostigma—Bering Sea.
ochotensis—Okhotsk Sea.
rhodosoma—Okhotsk Sea.
ingens—Japan Sea.
bristolense—Bristol Bay.
cephalus—Bristol Bay.
tunicatus—Labrador to Greenland.
herschelinus—Arctic coast of Alaska.
agassizii—northern Japan.

Certain of these species may be combined or divided when better known. The distribution of some will be extended and of others restricted. When this is done it will doubtless be seen that the principle stated by Jordan applies to the distribution of the species of *Liparis*.

Bathymetrical distribution.—The species of *Liparis*, as has been said, are most common in the tide pools and do not descend below 250 fathoms. The greatest vertical distribution for any one species is 175 or possibly 212 fathoms for *Liparis fucensis*. *Liparis dennyi* is known to range through about 100 fathoms. The majority of the species range through less than 50 fathoms. It may be found that, on account of the greater difference in temperature between the surface and bottom waters on the Japan coast, the species do not have as great vertical distribution as on the American coast.

Center of dispersal.—When we attempt to apply the criteria used by Adams (1902) and Ruthven (1908) in finding the center of distribution of a group we find that, of those applicable, certain ones point to northern Japan and the remainder to Bering Sea. At present we shall not attempt to distinguish between these two regions but shall designate Bering Sea as the center of dispersal for the genus.

At the time when there was a land connection between Asia and America (see J. P. Smith 1907) and the Arctic Current was prevented from entering Bering Sea the waters of the North Pacific were tempered by the warm Japan Current more than at present. The species of this genus must have retreated to Bering Sea and may have been exterminated there. When the land bridge subsided and the cold Arctic Current again chilled the North Pacific the species of *Liparis* remaining in Bering Sea or others from the Arctic Ocean migrated southward along the Asiatic and American shore lines. The subsidence of the land bridge across Bering Strait was at a sufficiently

remote period to allow specific differentiation to take place. There has been no recent intermigration between Asia and America, for the species of the two regions are distinct.

The distribution of the few North Atlantic species can readily be accounted for by assuming that they migrated from Bering Sea along the Arctic coast of America to the North Atlantic. Certain species crossed over to northern Europe and others migrated down the northeast coast of America to Connecticut. The species of the two shores are different. *Liparis liparis*, a European species, has been recorded from the New England coast, but the writer has been unable to verify this record. *Liparis atlanticus* extends from Connecticut to Labrador, *Liparis tunicata* from Labrador to Greenland, *Liparis major* from Greenland to the Kara Sea. The latter species may be circumpolar. *Liparis liparis* and *Liparis montagui* are European species.

Assuming that the genus originated in the North Pacific the most reasonable way by which we can account for the presence of species at the southern end of South America is by migration along the American coast line at some remote period when the tropical waters were sufficiently cooled to offer a favorable environment. At the present time a depth of 150 to 200 fathoms along the west coast of tropical America affords a sufficiently cool temperature for these fishes. But the genus is not represented there and is seems unlikely that the migration to the Antarctic has taken place under present conditions. During the Ice Age, conditions were more favorable than now and it was probably during this period that species of *Liparis* made their way across the Equator.

KEY TO SPECIES OF LIPARIS [12]

A[1]. Peritoneum pale or silvery, usually with sparsely scattered brown or black dots; pectoral in most of the species with more rays than the anal.
  B[1]. Caudal free from the dorsal or connected for not more than one-fifth its length; pectoral rays more numerous than the anal rays.
    C[1]. Dorsal notched; gill opening either above the pectoral or extending down in front of not more than 6 rays.
      D[1]. Anal less than 30; dorsal not more than 35; coeca less than 150.
        E[1]. Gill slit above the pectoral, sometimes appearing to extend down in front of the upper ray.
          F[1]. Disk 2 or less in the head.
            G[1]. Pyloric coeca less than 50 (15–37); anterior dorsal rays sometimes elevated. American.
              H[1]. Pectoral 26–29; no white bar at the base of the caudal. Atlantic ..... montagui, atlanticus.
              H[2]. Pectoral 30–33; a white bar across the base of the caudal. Pacific ..... rutteri.
            G[2]. Pyloric coeca more than 50 (65–70); anterior dorsal rays never elevated. Asiatic ..... curilensis.
          F[2]. Disk more than 2 in the head ..... callyodon. grebnitzkii.

[12] See supplementary key for North Atlantic species.

E². Gill slit extending down in front of 3 to 5 pectoral rays.
J¹. Disk usually more than 2 in the head in the adult; greatest depth of the body usually behind the origin of the second dorsal; color brownish or striped.....mucosus.
J². Disk 2 or less in the head; color slaty or olive gray; body deepest at the origin of the dorsal....micraspidophorus.
C². Dorsal unnotched, of if notched the gill slit extends down in front of more than 6 pectoral rays.
M¹. Pectoral with not more than 35 rays, less than the number of dorsal rays; gill slit in front of 10 or less pectoral rays.
N¹. Pectoral 29–32; gill slit extending down in front of 3–5 pectoral rays.....cyclopus.
N². Pectoral 34; gill slit in front of 9 pectoral rays frenatus.
M². Pectoral 38–43, with more rays than the dorsal; gill slit in front of 13–16 rays.....fucensis.
B¹. Caudel connected to the dorsal for more than one-fifth and less than three-fourths its length, or if connected for three-fourths its length the pectoral is unnotched; the number of pectoral rays greater than the number of anal rays.
O¹. Pectoral notched in adult and young.
P¹. Gill slit extending down in front of not more than 10 pectoral rays.
Q¹. Gill slit extending down in front of 6 or less pectoral rays; pyloric coeca less than 55. American.
R¹. Dorsal 38–40; anal 32–35; prickles apparently always present..bristolense.
R². Dorsal 41–44; prickles never present.
S¹. Pyloric coeca 36–48; gill opening in front of 3–6 pectoral rays..tunicatus.
S². Pyloric coeca 18–20 (?); gill opening in front of 0–3 pectoral rays herschelinus.
Q². Gill slit extending down in front of 6–9 pectoral rays; coeca more than 55; Asiatic.....agassizii.
P². Gill slit extending down in front of more than 10 pectoral rays; coeca less than 55.
T¹. Head blunt; width of head usually greater than the depth; head and body resembling the tide-pool forms; snout to disk usually less than 7.5 in the length. Flesh not pinkish.
U¹. Dorsal 37–40; no prickles; dorsal frequently notched. Coast of Washington and southeast Alaska.....dennyi.
U². Dorsal 40–44; no prickles. Bering Sea...cyclostigma, gibbus.

U³. Dorsal 45; prickles frequently present. Asiatic.

V¹. Inner teeth stout, strongly trilobed; jaws nearly equal; body stout. Saghalin, Okhotsh Sea_____**ochotensis.**

V². Inner teeth slender, weakly trilobed; upper jaw projecting and exposing nearly all of the teeth in front. Southern part of the Japan Sea_**ingens.**

T². Head pointed; width of head about equal to the depth; head and body not resembling the tidepool forms, having more the appearance of deep-water forms; snout to disk not over 7 in the length. Flesh pinkish. Okhotsh Sea_____**rhodosoma.**

T³. Head exceptionally heavy and blunt; snout not projecting, broadly rounded; width of head about equal to the depth; head and body not resembling the tidepool forms; snout to disk 7.8–8.4 in the length of the body without the caudal. Flesh not pinkish. Bering Sea_____**megacephalus.**

O². Pectoral unnotched in the adult and possibly in the young.

W¹. Dorsal 28_____**antarctica.**

W². Dorsal 40 or more.

X¹. Pectoral 32_____**steineni.**

X². Pectoral about 40.

Y¹. Head flattened in the nasal region, snout low and projecting **tanakae.**

Y². Head convex in the nasal region, not depressed; snout deep and short, not projecting_____**owstoni.**

B³. Caudal connected to the dorsal for three-fourths or more of its length; pectoral notched; the number of pectoral rays equal to or less than the number of anal rays.

Z¹. Gill opening above the pectoral or in front of 1 to 4 rays_____**pulchellus.**

Z². Gill opening in front of about 16 pectoral rays____**tessellatus.**

A^2. Peritoneum black or densely pigmented; pectoral with less rays than the anal ..... major.

SUPPLEMENTARY KEY TO SPECIES OF LIPARIS FROM THE NORTH ATLANTIC

(A^1) Peritoneum silvery or white, with few or no black dots.
(B^1) Anal less than 30; dorsal usually notched.
(C^1) Pectoral less than 30.
(D^1) Anterior dorsal rays sometimes elongate; prickles sometimes present; dorsal more than 30. Coeca usually more than 20. American ..... atlanticus.
(D^2) Anterior dorsal rays never elongate; prickles never present; dorsal 30 or less. European ..... montagui.
(C^2) Pectoral more than 30; coeca less than 20 ..... liparis.
(B^2) Anal more than 30 (34–37); dorsal never notched; dorsal 41–44; anal 34–37 ..... tunicatus.
(A^2) Peritoneum usually black, sometimes heavily pigmented with black. D. 48; A. 40; P. 34 ..... major.

LIPARIS ATLANTICUS Jordan and Evermann

Liparis montagui GARMAN, 1892, p. 47 (part, pl. 7, figs. 6–20, not of Donovan)
?*Liparis liparis* GARMAN, 1892, p. 59 (part, pl. 7, figs. 1–5, 21–22).
Neoliparis atlanticus JORDAN and EVERMANN, 1898, No. 47, p. 2107.

Type.—Male, No. 47215, U.S.N.M. Godbout, Quebec, 1885. Length 109 mm.

Distribution.—Specimens examined, 36 in number, are from the coast of Connecticut northward to Quebec. The records of the specimens examined are incomplete and do not indicate the vertical range of the species. It has been recorded from the tide pools down to 50 fathoms.

Relationships.—*L. atlanticus* has frequently been confused with *montagui* Donovan of Europe. Jordan and Evermann consider that the former species differ from the latter in the smaller head and the more distinct and sometimes elevated anterior dorsal fin. Boulenger (Jordan and Evermann, 1898. p. 2107) says that the anterior dorsal fin of *L. montagui* is always distinct but never elevated. I have been unable to make a satisfactory comparison of these two species but I am inclined to believe that they will be found to be distinct morphologically as well as geographically. In comparing *L. atlanticus* with the Pacific species we find that in most respects it bears a close resemblance to *L. rutteri.* The resemblance is more striking when we consider that these are the only two species in which the anterior dorsal fin is sometimes elevated. The only differences of taxonomic value that we find between *L. atlanticus* and *L. rutteri* are in the coloration and the number of rays in the pectoral fin. The disk may be found to be slightly larger in the latter species. *L. rutteri* apparently never has thumb-tack prickles. These are not

always present in *L. atlanticus* and so fail to serve as a constant means by which the species can be distinguished.

Description of the type.—D. 34; A. 27; P. 28; pyloric coeca 30. Depth in length, 4.4; head, 4.5. Eye in head, 5.6; disk, 1.8.

Body heavy anteriorly, moderately elongate. Head short, rather small; cheeks swollen; profile slightly depressed over the eyes. Mouth small, terminal; maxillary scarcely reaching beneath the front of the pupil. Teeth in broad bands, strongly trilobed; eight or nine oblique rows in the half of each jaw. Snout projecting. Anterior nostril in a prominent tube; posterior nostril not prominent, with a fingerlike projection in front. Eye small. Gill slit, small, either above the pectoral or extending down in front of the upper ray. Pores on the head and body normal; suprabranchial pores separated by the diameter of the eye. "Thumb-tack" prickles scattered over the head and body.

Dorsal with the five anterior spines elongate; second spine longest, a little longer than the head; tips of the elongated spines free; second dorsal rays increasing rapidly in length. Caudal truncate, connected to the anal for less than one-fifth its length; last dorsal and anal rays shortened, forming a notch. Pectoral notched; the lower lobe of six thickened, partly free rays, reaching midway between disk and vent. Disk large, less than 2 in the head. Vent separated from the disk, by 0.6 the diameter of the disk.

Color.—Body reddish brown; the bases of the "thumb-tack" prickles appear as scattered pale dots; peritoneum pale, faintly dotted with brown.

Synopsis.—Dorsal, 32–34; anal, 25–27; pectoral, 26–28; pyloric coeca, 19–37, typically more than 20. Eye 5.6–6.5 in the head; disk 1.8. Gill slit above the pectoral or extending down in front of one ray. Spinous dorsal usually distinct, sometimes hardly evident; the spines sometimes elevated. Caudal typically connected to the dorsal for less then one-fifth its length. Prickles present or absent. Color reddish brown to light olive brown; the caudal faintly barred; in some specimens bars extend from the dorsal and anal onto the body. A small species reaching a length of slightly more than 100 mm.

Remarks.—One of the Salem specimens has "thumb-tack" prickles scattered over the body as in the type. Five of the specimens examined have the spinous dorsal elevated. In our specimens the prickles and elevated spines are associated only with the males. Both of these characters are said to be typical of the male during the breeding season. The dorsal notch sometimes hardly evident. As some specimens of *L. liparis* have a shallow dorsal notch we can not depend on this character to separate the two species.

L. atlanticus may be the only described species of *Liparis* on our Atlantic coast. (See *L. tunicatus*.) Putman and later Garman (for other records see Kendall 1908 and Tracy 1909), record *L. liparis* from this region. Specimen No. 12958; Garman 1892 (pl. 7, figs. 1, 2, 3, 4), appears to be distinct from *L. liparis*. The number of coeca is greater and the disk is larger, both agreeing with *L. atlanticus*. The specimen is in such condition that the other characters can not be ascertained though the anal appears to be as figured, and the coloration striped. Some immature specimens from Block Island and Noank found in pectens seem to differ from *L. atlanticus* in the increased connection between the dorsal and the caudal. They probably, with No. 12958, represent some other species, possibly an undescribed one. These specimens have probably been separated from *L. atlanticus* and placed with *L. liparis* because of the absent or obscure dorsal notch and the extent of the connection between dorsal and caudal fin.

Specimens of *L. atlanticus* one-half inch in length have been taken on the 31st of July. Putman (1873, 339), records that the spawning season is in March.

LIPARIS MONTAGUI (Donovan)

Cyclopterus montagui Donovan, 1805, pl. 68.
Liparis montagui Gunther, 1861, p. 161.

Distribution.—Coasts of northern Europe, recorded from the north of France northward. No specimens examined.

Relationship.—A discussion of the possible differences between *L. montagui* and *L. atlanticus* are given in the description of the latter.

LIPARIS RUTTERI (Gilbert and Snyder)

Neoliparis rutteri Gilbert and Snyder, 1898, in Jordon and Evermann, 1898, p. 2108.—Evermann and Goldsborough, 1907, p. 331, fig. 99.

Types 3, No. 5701, S. U. Z. M., Uyak Bay, Kodiak Island, Alaska; Rutter, 1903. Length 65 mm.

Distribution.—Known from the southeast coast of Alaska and the Aleutian Islands; tide pools to 16 fathoms. Twenty-four specimens examined.

Relationship.—*L. rutteri* closely resembles *L. atlanticus*. The only differences between the two species are found in the coloration and the number of pectoral rays. *L. rutteri* appears to have a slightly larger disk than *L. atlanticus* and never has prickles. *L. rutteri* can be distinguished from all the Pacific species by the large disk combined with the coloration.

Synopsis.—Dorsal 31–32; anal 23–26; pectoral 30–33; pyloric coeca 23–31. Disk 1.4–1.7 in head. Gill slit above the pectoral. Spinous dorsal usually distinct but sometimes hardly evident; the spines sometimes elevated. Caudal typically connected for less than one-fifth its length to the dorsal. Disk large, less than 2 in head. Prickles

apparently never present. Color variable, usually distinct in the presence of a white bar across the base of the caudal and the posterior margin of the dorsal and anal fins. A small species, the largest specimen being 63 mm. in length.

Remarks.—The elevated dorsal is not always present in the male, for one of our specimens, a male from Agattu, has a very low dorsal. None of the female specimens examined have an elevated dorsal. Four of the specimens exhibit the striped color pattern; of these 1 is from Karluk, 2 from Loring, and 1 from Station 4205, Admiralty Inlet. Apparently no morphological differences can be correlated with the striped color pattern. The specimen from Station 4205 is the only one taken in the dredge. It differs from the others in the paler coloration. In addition to the stripes—the color of this specimen is as follows: Light ashy brown, darker posteriorly; margin of dorsal and anal dusky; caudal finely crossbarred. The white bar at the base of the caudal apparently is distinctive of the species though absent in one specimen and faint in others.

LIPARIS CURILENSIS (Gilbert and Burke)

Cyclogaster curilensis Gilbert and Burke, 1912*b*, p. 353.

Type.—Female, No. 73326, U.S.N.M. Simushir Island, Japan. *Albatross*, 1906. Length 110 mm.

Distribution.—Known only from the type locality. Thirty-two specimens examined.

Relationship.—In general appearance and in coloration this species resembles *L. callyodon.* It can be distinguished from the latter by the much larger ventral disk. In the size of the disk *L. curilensis* agrees with *L. rutteri.* It is readily distinguished from the latter by the coloration and number of pyloric coeca. The coloration does not differ materially from that of *L. callyodon* though usually the cross bars are much more pronounced. None of our specimens exhibited the spotted coloration sometimes shown by *L. callyodon.*

Synopsis.—Dorsal 34–35; anal 26–27; pectoral 29–30; pyloric coeca in one specimen 65. Disk large, 1.5–2 in head. Gill slit above the pectoral or extending down in front of the upper pectoral ray. Dorsal notched. Dorsal and anal barely or not at all connected with the caudal. Coloration as in *L. callyodon.*

LIPARIS CALLYODON (Pallas)

Cyclopterus callyodon Pallas, 1811, p. 75.
Liparis mucosus Garman, 1892, p. 52 (part, not of Ayers).
Nectoliparis callyodon Jordan and Evermann, 1898, p. 2110, fig. 760.—Evermann and Goldsborough, 1907, p. 332, fig. 100.

Distribution.—*L. callyodon* is common in the tide pools along the southeastern coast of Alaska and the Aleutian Islands. The collec-

tions examined contained specimens from points as far south as Port Townsend, Wash., and as far north as St. Paul Island, Bering Sea. The author doubtfully records three small and poorly preserved specimens form Petropavlosk and Plover Bay, Siberia. This species is not found in tide pools in its southern range.

Relationship.—*L. callyodon* appears to be most closely related to *L. curilensis* of the Kurile Islands. It appears to differ from the latter species mainly in the smaller size of the ventral disk. In other respects the two species appear similar.

Synopsis.—Dorsal 33–35; anal 26–27; pectoral 29–31; pyloric coeca 42–66. Disk moderate, 2.2–3 in the head. Gill slit either above the pectoral or extending down in front of the upper pectoral ray. Dorsal fin distinctly notched. Dorsal and anal connection with the caudal not extending beyond the skin covered base of the latter. Prickles never present. Coloration variable; for a description of the several types see remarks. A small sized species reaching a length of about 100 mm.

Remarks.—The gill slit in this species varies somewhat. It may appear to be above the pectoral or extending down in front of the upper ray. The following types of coloration are exhibited by specimens in the United States National Museum.

(1) Purplish above, varying to olive-brown on the sides, paler below; fins finely crossbarred or not.

(2) Light olive to an olive brown; fins finely barred.

(3) Tawny to olive brown, paler below, punctulate with dark dots; fins faintly barred.

(4) Olive brown mottled with ash; the sides sometimes with round dark spots about the size of the pupil.

In addition to the variation in the coloration there is considerable variation in shape and depth of body and head in specimens from different localities. The variation in the number of fin rays and size of disk falls within narrow limits and the author is unable to satisfactorily designate local races. With the acquisition of more data it may be possible to divide the species into local races based on color and form. Other tide-pool species of Bering Sea, such as *Pallasina carbata*, exhibit local peculiarities. The islands of Bering Sea offer a splendid opportunity to study the effect of deep channels as barriers to the ready dispersal of the tide-pool species and if they act as barriers, the effect of isolation in the formation of species.

Some of our specimens from Bering Island, collected by Grebnitzki, agree fairly well with the description of *L. grebnitzkii* Schmidt. *L. grebnitzkii* appears to be a color form of *L. callyodon*.

LIPARIS GREBNITZKII (Schmidt)

Neoliparis grebnitzkii SCHMIDT, 1904*a*, p. 165, pl. 6, fig. 4.

Type.—Female, No. 8855, museum of St. Petersburg, Bering Island. Grebnitzki. Length 83 mm.

Distribution.—Known only from Bering Island. No specimens examined.

Relationship.—Schmidt (1904*a*) considers this species to be most closely related to *L. rutteri*. I can not agree with him and believe *L. grebnitzkii* to be most closely related to *L. callyodon* and possibly identical with it. I am unable to detect any important differences between the two species.

Synopsis.—Taken from the original description. Dorsal 32; anal 27; pectoral 29; caudal 10; pyloric coeca about 30; eye 6.6; snout 3.1; disk 2.2. Gill slit above the pectoral. Color tawny; head and back brown; fins grayish; pectoral yellowish, without spots.

LIPARIS MUCOSUS (Ayers)

Liparis mucosus AYRES, 1855, vol. 1, p. 24; 1873, vol. 1, p. 22.—GARMAN, 1892, p. 52, pl. 5, figs. 1–5 (part).—JORDAN and STARKS, 1895, ser. 2, vol. 5, p. 832, pl. 95.—JORDAN and EVERMANN, 1898, p. 2111, fig. 761.

Neoliparis florae JORDAN and STARKS, 1895, ser. 2, vol. 5, p. 830, pl. 96.—JORDAN and EVERMANN, 1898, p. 2111, fig. 762.

Type.—Destroyed. San Francisco.

Distribution.—Northwest coast of America from Pacific Grove, Calif., to Kodiak Island, Alaska. A tide-pool and shallow-water species. Twelve specimens examined.

Relationships.—*L. mucosus* is most closely related to a twin species, L. *micraspidophorus*, from the Aleutian Islands. It can be distinguished from the latter species by the coloration and the shape of the head and body. In addition to the above differences the disk is slightly smaller in *L. mucosus*. The coloration of the body and peritoneum, the shape of the head and body, and the size of the gill slit and disk readily distinguish this species from all other species with an equal number of fin rays inhabiting the same regions.

Synopsis.—Dorsal 31–33; anal 25–27; pectoral 30–33; pyloric coeca 48?–70. Disk 2.1–2.4, in the head. Gill slit extending down in front of from 1 to 6 pectoral rays, usually in front of more than 3 rays. Dorsal notch distinct, the anterior dorsal fin sharply pointed. Dorsal and anal connections with the caudal very short, little, or not at all, extending beyond the skin-covered base of the latter. Prickles present or absent. Head and anterior part of body appearing depressed; greatest depth of body usually at the end of the first third of the second dorsal fin. Color dark brown to light yellowish brown, paler below, sometimes with longitudinal wavy stripes; fins colored as the body or faintly barred; first dorsal sometimes a dark blotch. A small-sized species, reaching a length of 125 mm.

Remarks.—In this species the head is usually thrown upward, giving the body the appearance of being depressed in front of the first dorsal fin. In a normal specimen the depth increases gradually to the end of the first third of second dorsal; sometimes the depth is as great at the origin of the first dorsal, but it never exceeds that under the second dorsal; dorsal outline of body convex under middle of second dorsal. The gill slit sometimes extends down in front of only one pectoral ray and then resembles the gill slit in some specimens of *L. callyodon.*

The coloration varies from a drab brown to a light yellowish brown; it lacks the slaty cast of *L. callyodon* and in this respect more nearly resembles *L. rutteri.* The fins may be colored as the body or faintly barred; the tip of the first dorsal sometimes with a dark blotch. A small specimen 55 mm. in length has light wavy lines on

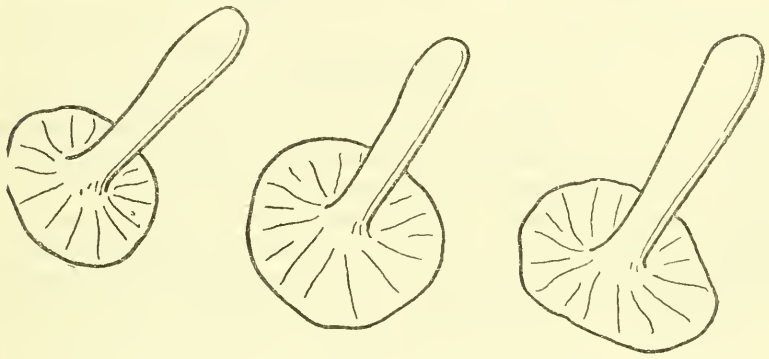

FIGURE 2.—LIPARIS MUCOSUS. PRICKLES FROM SPECIMEN FROM PACIFIC GROVE, CALIF.

the body and head as in *L. pulchellus.* The disk of this specimen is large and is contained 1.7 in the head. One of the Pacific Grove specimens has the body and the top of the head and cheeks covered with "thumbtack" prickles; these extend onto the fins. These prickles are not a sex character, unless seasonal, for one of the Pacific Grove specimens, a male, does not possess them. The prickles in this species are club shaped—that is, heavier near the tip than the base. The anterior nostril tube is sometimes very short and the rim dark.

The specimens from Karluk and Neah Bay are very similar to the type of "*Neoliparis florae*" and easily recognized as belonging to the same species. The Pacific Grove specimens are larger and present slight peculiarities which are not of specific value.

Jordon and Starks (1895, p. 832) describe what they consider to be a specimen of "*Neoliparis mucosus*" as follows: Head 4; depth 4.3. Dorsal 6–26; anal 26; pectoral 29; caudal 12. Eye 7; disk 1.5. Body holding its depth well past the middle. Nostrils not ending in tubes. Gill slit not extending below the upper edge of the pec-

toral. Color olive-brown, light below; indistinctly mottled; dorsal and anal darker at the margin; pectoral uniform dark brown; caudal light, with indistinct cross lines; lips dark.

This specimen has a very large disk and is here doubtfully referred to *L. mucosus*. The gill slit is described as being above the pectoral and the nostril tube absent. In some of our specimens of *L. mucosus*

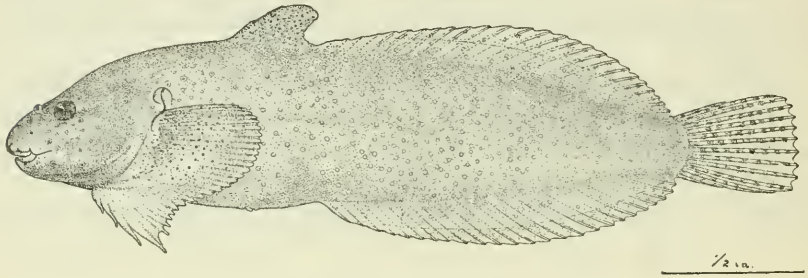

FIGURE 3.—LIPARIS MICRASPIDOPHORUS. TYPE. A TYPICAL TIDE POOL SPECIES, WITH NOTCHED DORSAL AND FREE CAUDAL FIN

the gill slit extends down in front of only one pectoral ray and the nostril tube is very short. It seems likely that the Jordan and Starks specimen belongs with this species.

The following note is from the original description by Ayers: Head 4 in the total length; eye nearly 6 in the head. Dorsal and anal terminate at the base of the caudal. Dorsal notched. Gill opening as in *L. pulchellus*. (The gill slit in *L. pulchellus* is described by Ayres

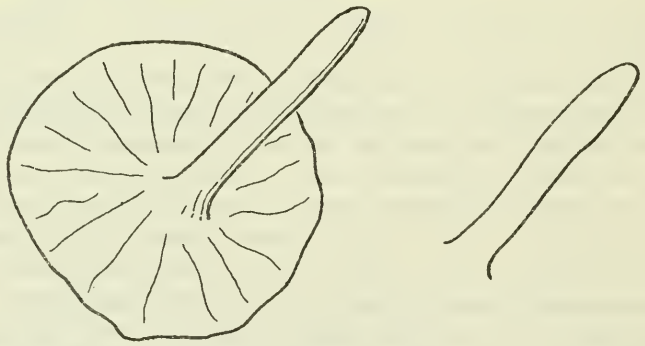

FIGURE 4.—LIPARIS MICRASPIDOPHORUS. PRICKLES FROM TYPE

as being above the pectoral, but it extends down in front of two or three rays.) Anterior nostril tubular. Disk as in *L. pulchellus*. (The disk in *L. pulchellus* is contained more than two times in the head.) Color plain greenish olive, lighter below.

There is little in this description to indicate that the species described by Ayres as *Liparis mucosus* is different from the species described by Jordan and Starks as "*Neoliparis florae*." I believe

the species are identical and here reduce *florae* to the synonomy of *mucosus*.

LIPARIS MICRASPIDOPHORUS (Gilbert and Burke)

Cyclogaster micraspidophorus GILBERT and BURKE, 1912*a*, p. 71.

Type.—Male, No. 74379, U.S.N.M., Nikolski, Bering Island. *Albatross*, 1906. Length 73 mm.

Distribution.—Known only from Agattu and Bering Islands. A tide-pool species. Four specimens examined.

Relationships.—*L. micraspidophorus* appears to be most closely related to *L. mucosus*. It differs from the latter species in the shape of the body, greater depth, more swollen cheeks, slightly larger disk, in the shape of the prickles, and in the coloration. In other respects the two species appear to be similar.

Synopsis.—Dorsal 31–32; anal 25–27; pectoral 30–32; pyloric coeca 55–65; disk 1.7–2 in the head. Gill slit extending down in front of 4–5 pectoral rays. Dorsal notch deep. The connection between the dorsal and the caudal equal to the skin-covered base of the latter. Prickles present or absent. Body slate colored above, paler below; vertical fins indistinctly speckled and barred; upper half of pectoral speckled. In life uniform brownish red. A small sized species, none of our specimens reaching a length of 100 mm.

FIGURE 5.—LIPARIS MICRASPIDOPHORUS. TEETH FROM TYPE

Remarks.—The swollen occiput is not so noticeable in the cotype, and the color varies to an olive gray somewhat resembling the typical coloration of *L. callyodon*. The lower lobe of the pectoral appears shorter than in *L. mucosus*.

LIPARIS LIPARIS (Linnaeus)

Cyclopterus liparis LINNAEUS, 1776, p. 414.

Distribution.—Coast of northern Europe. Recorded from the northeastern coast of America and Japan. The possibility of this species being on the American coast is discussed in the account of *L. atlanticus*. The Japanese record, (Franz, 1910), is very doubtful and will doubtless be found to be that of another species. (See remarks.)

Relationship.—The relationship of *L. liparis* with the other known species is obscure. In the small number of pyloric coeca it agrees with *L. antarctica* but the two species differ widely in other characters. *L. liparis* is readily distinguished from the other species of the North Atlantic by the number of fin rays, absence of a distinct dorsal notch, the distinct connection between the dorsal and anal and the caudal fin, and the small number of pyloric coeca.

Description.—Description of a number of specimens from the Cheshire coast of England.

Dorsal 34–35; anal 29; pectoral 32–33; disk a little more than 2 in the head.

Body heavy, short. Head heavy, blunt, depth equal to or greater than the width. Cheeks nearly vertical; occiput high. Mouth broad, with little lateral cleft. Teeth strongly tri-lobed, arranged in about 12 oblique rows in the half of each jaw. Snout bluntly rounded; lower jaw included. Eye small, silvery. Gill slit small, extending down in front of one to three pectoral rays. Anterior nostril in a short tube. Coeca 10–13, in a single row about the gut.

Dorsal usually with a shallow notch setting off the first five rays. Dissection of the fin will show that in most of the specimens the fifth and sixth rays are slightly shortened. Sometimes they appear to be of the same length as the preceding rays. In none of our specimens do the rays increase regularly in length. Caudal truncate, of 12 rays, connected for a little more than, or about one-fifth its length to the dorsal. Pectoral notched; the lower lobe reaching nearly to the vent. Disk more than 2 in head. Vent separated from the disk by the diameter of the latter.

Color.—Slaty to brownish; the fins speckled to mottled or barred with brown. Peritoneum silvery, with few or no dots. A few of the specimens have pale stripes along the top and sides of the head.

Synopsis.—Dorsal 34–35; anal 29; pectoral 32–33; pyloric coeca 10–13, typically less than 20. Disk more than 2 in the head. Gill slit extending down in front of from one to three pectoral rays. Dorsal fin appearing to be unnotched, but upon dissection the fifth and sixth rays will usually be found to be slightly shortened. Caudal connected for a little more than, or about, one-fifth its length to the dorsal fin. Prickles absent. Color variable; many color varieties described; our specimens slaty to brownish; the fins speckled, mottled, or barred with brown; some of the specimens with pale stripes on head and body.

Remarks.—Many color varieties of this species have been described. This species and in fact all the species of Europe need a thorough revision based upon a large series of specimens. It is likely that other species have been confused with *L. liparis.*

Ehrenbaum (1905) records the spawning season from November to February. Smith (1897) records this species as common in winter and full of spawn in December and January. (In the discussion of *L. atlanticus* I have intimated that the specimens from the New England coast recorded as *L. liparis* will doubtless be found to be that of another species.)

Franz (1910) records two specimens of *Liparis liparis* from Japan. Franz has the following to say about these specimens:

> Dorsal 32; anal 26. Nach vergleichung meiner Exemplare mit solchen von Helzoland kann ich keine spezifischen Untersheide den letzteren gegenüber

finder. Flossen strahlenzahlen wie die des vorliegenden Exemplares komeen auch bei europäischen, wenn auch als unteres Extrem, vor. Die Formen des Flossen, die Dimensiones der Körpers stimmen genau mit denen der hiesigen Tiere überein, und auch die Färbung fällt innerhalb des sehr grossen variationsbereishes der europäischen Form. Die Zeichnung des einen Exemplares ist in des Figur angegeben. Grundton purpurrot.

Ein Exemplar von Fubuura, 7.5 cm. lang, coll. Haberer; ein Zweiter von Misake, 8.6 cm. lang, coll. Doblein.

The figure (pl. 9, fig. 76) presents the following: Gill slit not distinct but appearing to be above the pectoral fin. The connection between the dorsal and caudal fins short, shorter than in *L. agassizii.* Body with longitudinal light stripes.

The combination of fin rays, unnotched dorsal, short connection between dorsal and caudal, and the coloration serves to distinguish these specimens from all the other Pacific species. The number of fin rays as given by Franz is less than typical for *L. liparis;* and this, with the distribution, leads me to believe that Franz has erred in referring his specimens to *L. liparis.*

LIPARIS CYCLOPUS Günther

Liparis cyclopus Gunther, 1861, p. 163.—Jordan and Starks, 1895, p. 834, pl. 97.—Gilbert, 1896, p. 446.—Evermann and Goldsborough, 1907, p. 332, pl. 18.

Type.—Esquimault Harbor, Vancouver Island. Length 45 lines.

Distribution.—The specimens examined are from Petropavlovsk (see remarks), Bering Island; Puget Sound; Port Angeles, Wash.; Point Moller, Alaska; *Albatross* Station 3230, Bering Sea. If the Petropavlovsk specimens prove to be identical with the American species, *L. cyclopus* will be one of the few shallow-water species existing on both sides of the deep Kamchatkan Channel. *L. cyclopus* is not common in the shallow tide pools but prefers slightly deeper water.

Relationships.—*L. cyclopus* does not appear to be closely related to any known species. It, with *L. frenatus* and *L. fucensis,* presents transition characters between the tide pool and more highly modified species of the genus. In these three species the dorsal fin is unnotched, or the notch but faintly indicated, the number of fin rays is intermediate, the gill slit extends down in front of the pectoral fin, and the connection between the dorsal and caudal is very short. *L. cyclopus* is distinguished from *L. frenatus* and *L. fucensis* by the smaller number of pectoral rays and the narrow gill slit. The shape of the body in *L. cyclopus* resembles that of *L. mucosus,* a species extending farther to the south. The two species differ in the presence or absence of the dorsal notch and the number of fin rays, and do not appear to be closely related.

Description.—The following description is of a specimen from Point Moller, Alaska, No. 24007, U.S.N.M.

Dorsal 35; anal 29; pectoral 29; pyloric coeca 39. Depth 5 in length without caudal; head 5.25. Eye 6.2 in head; disk 2.5.

Body shaped somewhat as in *L. mucosus*; the depth retained to beneath the second dorsal. Head low, wider than deep; occiput not swollen; profile rising gradually, depressed over the eyes. Mouth wide, terminal; maxillary reaching vertical in front of eye. Snout low, jaws equal. Teeth slender, recurved; the lateral lobes small. Anterior nostril in a prominent tube; posterior nostril with a low rim. Gill slit extending down in front of 5 pectoral rays; 3.8 in head.

Dorsal unnotched, origin behind middle of pectoral; caudal of 10 rays. Dorsal and anal connection to the caudal very short, extending little, if at all, beyond the skin-covered base of the latter. Pectoral notched, the lower lobe of six rays, reaching a little more than halfway between disk and vent. Disk moderate. Vent about midway between disk and anal.

Olivaceous above, paler below; body and fins speckled with olive brown. Peritoneum pale, with sparsely scattered black dots.

FIGURE 6.—LIPARIS CYCLOPUS. TEETH FROM A SPECIMEN FROM PUGET SOUND

Synopsis.—Dorsal 35; anal 29; pectoral 29; pyloric coeca 39. Disk 2.5 in the head. Gill slit extending down in front of five pectoral rays. Dorsal fin unnotched, the connection with the caudal not extending beyond the skin-covered base of the latter. No prickles. Body somewhat depressed anteriorly, the greatest depth retained to beneath the second dorsal. Color olivaceous above, paler below; body and fins speckled with light olive brown. A small-sized species.

Remarks.—*L. cyclopus* is a flabby appearing species with a broad, low head. It is easily recognized at sight in the adult stage. The specimens from Petropavlovsk are immature and may represent an undescribed species. The specimens from Kamchatka may have a smaller gill slit and the snout more evenly rounded than the American specimens of the species.

The following details are from the larger Kamchatka specimen. Head 4 in length without caudal; depth 4.7. Dorsal 37; anal 30; pectoral 32. Eye 5 in head; snout 3; disk 2; gill slit extending down in front of 3 pectoral rays.

LIPARIS FRENATUS (Gilbert and Burke)

Cyclogaster frenatus GILBERT AND BURKE, 1912*b*, p. 356.

Type.—Female, No. 73329, U.S.N.M. *Albatross* Station 4809, Japan Sea; depth 207 fathoms.

Distribution.—Japan Sea, only the type known, apparently a deep-water species.

Relationship.—*L. frenatus* is not closely related to any known species. It can be distinguished from *L. cyclopus*, which it resembles in many characters, by the increased number of fin rays, the large gill slit, and the narrow head.

Synopsis.—Dorsal 37; anal 31; pectoral 34; pyloric coeca 21; disk 2.5 in the head. Gill slit extending down in front of nine pectoral rays. Dorsal fin unnotched, connected to the caudal fin for less than one-fifth of the length of the latter.

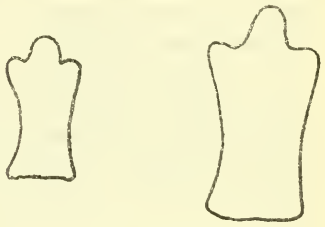

FIGURE 7.—LIPARIS FRENATUS. TEETH FROM TYPE

Remarks.—*L. frenatus* has an unusually narrow head and in this respect resembles the typical forms of *Careproctus*. The reddish color also suggests an approach to the condition found in *Careproctus*.

LIPARIS FUCENSIS Gilbert

Liparis fucensis GILBERT, 1896, p. 447.—JORDAN AND EVERMANN, 1898, p. 2119.
Liparis callyodon GARMAN, 1892, p. 54, pl. 6, figs. 1–5.
Neoliparis fissuratus STARKS, 1896, p. 560.—JORDAN AND EVERMANN, 1898, p. 2113.

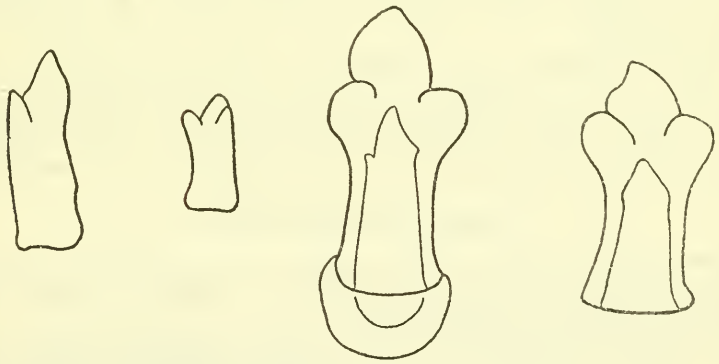

FIGURE 8.—LIPARIS FUCENSIS. TEETH FROM TYPE

Type.—Female, No. 48600, U.S.N.M., Straits of Juan de Fuca, *Albatross* Station 3451; depth 106 fathoms. Length 110 mm.

Distribution.—Coast of Washington and southeastern Alaska, *Albatross* Stations 2865, 3451, 3452, 3461, 4302, and from Port Ludlow, Wash.; depth, shallow water down to 212 fathoms, at present not known to inhabit the tide pools. Thirteen specimens examined.

Relationship.—*L. fucensis* apparently is not closely related to any known species. In the character of gill opening and increased number of pectoral rays it represents a transition stage between

the lower and higher members of the genus. It still retains in reduced form the primitive notch in the dorsal fin. The short connection between the dorsal and caudal fins also is primitive. It differs from all other species in the family in having more rays in the pectoral than in the dorsal fin. The teeth also appear to have distinctive characteristics, rather short and stout; the lateral lobes not in the same plane as the central lobe; the lobes flattened and thin near the margins.

Synopsis.—Dorsal 33–35; anal 27–29; pectoral 38–43; pyloric coeca 26?–55. Disk 2.5–2.8 in the head. Gill slit extending down in front of 13–16 pectoral rays. Dorsal fin unnotched or with a shallow notch which becomes evident upon dissection. More rays in the pectoral than in the dorsal fin. Dorsal connection with the caudal very short, little if any extending beyond the skin-covered base of the latter. No prickles. Color olive brown to brownish. A small-sized species reaching a length of 110 mm.

Remarks.—The dorsal fin in this species is usually if not always notched. In all the specimens examined, with the exception of a mutilated individual, the notch in the dorsal fin could be detected by dissection. In the mutilated indivdual the anterior dorsal rays were broken and some of them absent, so that the presence or absence of a notch could not be ascertained. In the type or *Neoliparis fissuratus* Starks, the first seven dorsal rays are unsegmented. *N. fissuratus*, as has been pointed out by Gilbert and Thompson, 1905, is identical with *L. fucensis*.

A notch is usually present between the caudal and anal fins. The lower lobe of the pectoral in some specimens reaches halfway between disk and vent, while in others it reaches to the vent. The coloration varies from that described for the type to a plain olive brown dusted with dark dots.

LIPARIS BRISTOLENSE (Burke)

Cyclogaster bristolense BURKE, 1912*a*, p. 568.

Type.—Female, No. 53790, U.S.N.M.; vicinity of Bristol Bay, Bering Sea; *Albatross* Station 3514.

Distribution.—Southeastern Bering Sea, *Albatross* Stations 3247, 3301, 3514, 3518; depth 17 to 36 fathoms. Twelve specimens examined.

Relationship.—The distribution, shape of body and the presence of prickles suggest a close relationship between *Liparis bristolense* and *Liparis megacephalus*. The latter species appears to be distinct in having a larger number of dorsal rays, a larger gill slit, and the dorsal notch absent. *Liparis bristolense* differs from *Liparis tunicatus* and *Liparis herschelinus* in the smaller number of dorsal rays and the coloration. It differs from *Liparis agassizii* in the smaller number of dorsal rays and pyloric coeca, the coloration, and the smaller gill slit.

Synopsis.—Dorsal 38-40; anal 30–35; pectoral 33–37; pyloric coeca 16–22. Disk 1.7–2.2 in head, typically less than 2. Dorsal fin usually with a shallow notch. Connection between dorsal and caudal usually two-fifths the length of the caudal. Color variable.

LIPARIS MEGACEPHALUS (Burke)

Cyclogaster megacephalus BURKE, 1912*a*, p. 569.

Type.—Female, No. 53791, U.S.N.M.; Southeastern Bering Sea, *Albatross* Station 3519; depth 37 fathoms. Length 145 mm.

Distribution.—Southeastern Bering Sea, *Albatross* Stations 3518, 3519, 3520; depth 36 to 38 fathoms. Three specimens examined.

Relationship.—*Liparis megacephalus* resembles *Liparis major* in the heavy head and body but is otherwise distinct. For comparison with *Liparis bristolense* see description of latter species.

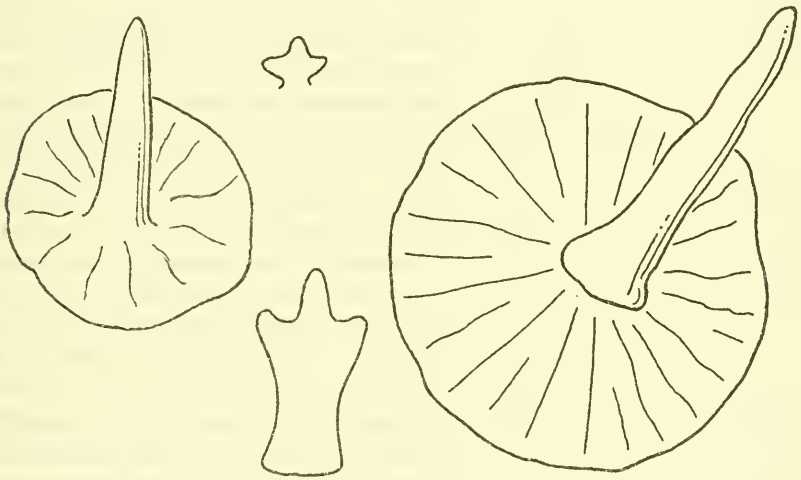

FIGURE 9.—LIPARIS BRISTOLENSE. PRICKLES AND TEETH FROM COTYPE

Synopsis.—Dorsal 43–44; anal 36; pectoral 36–38; pyloric coeca 29–31. Disk 2 in head. Gill slit extending down in front of 12 pectoral rays. Dorsal unnotched. Dorsal connected to the caudal for two-fifths caudal. Prickles present.

LIPARIS TUNICATUS Reinhardt

Cyclopterus liparis minor FABRICIUS, 1780, p. 135.
Liparis tunicata REINHARDT, 1836, p. CXI.
Liparis arctica GILL, 1864, p. 191.
Liparis tunicatus GARMAN, 1892, p. 65.

Distribution.—Apparently common in Arctic waters about Greenland and Labrador. One of our specimens, which is doubtfully placed with this species, is from Nauset Beacon, Mass. A tide-pool and shallow-water species. Thirty-one specimens examined.

Relationship.—L. tunicatus is closely related to *L. herschelinus*. The types of *L. herschelinus* are small and pressed out of shape, so that an accurate description is impossible. The author has not compared specimens of the same size of the two species, but it appears that in *L. tunicatus* the gill slit extends farther down in front of the pectoral fin and the number of pyloric coeca is greater than in *L. herschelinus*.

Description.—Description of several specimens from Labrador, collected by L. M. Turner.

Dorsal 41–44; anal 35–37; pectoral 35–37; pyloric coeca 38–48. Depth 4–4.7, in length without caudal; head 3.6–3.8. Eye 5.3–6.3 in the head; disk 2.2–2.4.

Body robust, deepest at front of first dorsal. Head heavy and broad; occiput slightly swollen; cheeks swollen; profile depressed over eyes. Mouth broad, nearly terminal; maxillary reaching vertical from pupil. Teeth short, stout, arranged in about 11 oblique rows in the half of each jaw; the lateral lobes appearing nearly as prominent as the central lobe. Eye small. Gill slit extending down in front of three to six pectoral rays in adults, in young specimens apparently not extending as far down in front of the pectoral fin. Prickles absent.

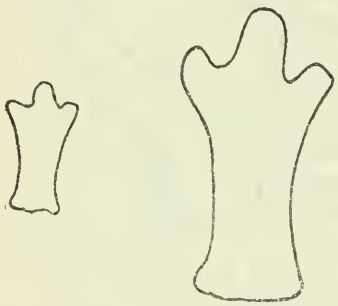

FIGURE 10.—LIPARIS TUNICATUS. TEETH FROM SPECIMEN NO. 34168, U.S.N.M. FROM LABRADOR

Dorsal fin unnotched; the origin over the end of the first third of pectoral. Caudal slightly rounded, of 10 rays, connected for about one quarter its length to the dorsal; dorsal and anal connection with the caudal, gradual, the last rays not shortened and forming a notch. Pectoral fin notched; the lower lobe of seven rays, reaching halfway between disk and vent or beyond. Disk rather large, with a broad flap. Distance from disk to vent, 2.5 to 3.4 in head.

Color: The specimens examined exhibit two types of coloration: (1) Represented by No. 34163, upper parts of head and body brownish; a pair of pale stripes extending from tip of snout through nostrils and along top of head, uniting at the origin of the dorsal, then deflected downward along the sides of the body to the base of the caudal; a second extending backward from the snout below the eye and across the gill slit, hence it is deflected downward on the sides to near the base of the anal and then backward to the base of the caudal; peritoneum silvery, black dotted; outer half of vertical fin darker; (2) body gray, slaty brown; skin finely dusted with brown dots, paler below; dorsal and anal with the base pale and the outer half dark brown; caudal uniform brown or speckled and crossbarred with brown; the base unusually pale; pectoral pale or speckled with brown.

Synopsis.—Dorsal 41–43; anal 34–35; pectoral 35–38; pyloric coeca 36–48. Disk 2.2–2.4. Gill slit extending down in front of from three to five pectoral rays. Dorsal fin unnotched. Dorsal fin connected to the basal fourth of the caudal fin. No prickles. A medium sized species, our largest specimen 121 mm. in length.

Remarks.—Specimen No. 31533, U.S.N.M., from Nauset Beacon, Mass., is doubtfully placed with the species. The gill slit extends down in front of the pectoral fin as in *L. tunicatus*, but the fin rays can not be counted. It is possible that this specimen belongs to the same species as the specimen doubtfully recorded as *L. atlanticus*. It is to be regretted that these specimens are in such condition that we can not ascertain their relationships.

LIPARIS HERSCHELINUS Scofield

Liparis herschelinus Scofield, 1899, p. 504, pl. 7.—Evermann and Goldsborough, 1907, p. 333, pl. 18.

Type.—No. 5601, S. U. Z. M.; Herschel Island, Arctic Ocean. The type bottle contains 17 small specimens; length 37–64 mm.

Distribution.—Known only from the tide pools of Herschel Island. Seventeen specimens examined.

Relationships.—*L. herschelinus* is very closely related to *L. tunicatus*. The former species appears to have a smaller number of pyloric coeca and a smaller gill slit than the latter. These differences may not be found to hold, as the type specimens of *L. herschelinus* are small and in poor condition and do not permit of satisfactory comparison to be made with *L. tunicatus*. It is possible that the two species are identical.

Description of the types.—Dorsal 44; anal 35; pectoral 37; pyloric coeca 18. Depth 4.4 in length without caudal; head 3.5. Eye 4.3 in head; disk 2.2.

Head and body distorted and not satisfactory for a description. Teeth stout, in about 9 oblique rows in the half of each jaw. Snout slightly projecting. Anterior nostril in a short tube; posterior nostril without a tube. Eye small. Gill slit in some specimens appearing to be above the pectoral fin and in others extending down in front of 1 to 2 or 3 pectoral rays; the distorted condition of the bodies probably accounts for some of this variation. Pyloric coeca in one specimen 18.

Dorsal fin unnotched; about 10 rays unsegmented. Caudal slightly rounded, connected for about one-fourth its length to the dorsal; no notch between dorsal and caudal or anal and caudal; anal connection to the caudal a little greater than dorsal connection. Pectoral fin with a shallow notch; the lower lobe short, reaching a little past disk. Disk moderate. Vent nearer anal fin than disk, separated from disk by diameter of disk.

Skin transparent, dusted above and on sides with dark punctulations, pale or straw colored beneath; anal crossed by faint blotches; outer half of the dorsal fin darkened posteriorly; caudal with a dark bar near the base and a faint narrow bar near the tip of the fin. Peritoneum pale, with sparsely scattered black dots.

Synopsis.—Dorsal 44; anal 35; pectoral 37; pyloric coeca 18. Disk 2.2 in head. Gill slit above the pectoral or extending down in front of 1 to 2 or 3 pectoral rays. Dorsal fin unnotched. Dorsal fin connected to the basal fourth of the caudal. No prickles. A small-sized species, our specimens reaching a length of 64 mm.

LIPARIS AGASSIZII (Putnam)

Liparis agassizii PUTNAM, 1874, p. 339.—GARMAN, 1892, p. 62, pl. I–III, (part).

Type.—Sagahlin, Channel of Tartary. Pierce and Smith. Length 250 mm.

Distribution.—*L. agassizii* is the common species of northern Japan. The limits of its distribution to the northward are unknown but it certainly is not found in Bering Sea as has been recorded. It extends down on the east coast of Hondo as far south as Same and Miyako. Smith and Pope (1906), record specimens obtained at the Shiogama fisheries station, Matsushima Bay; these specimens may have been collected elsewhere and may also belong to some other species, possibly *L. tanakae.* The specimens examined were obtained at Otaru, Aomori, Hakodate, Tomakomai, Same, Miyako, and *Albatross* Station 4808, Tsugaru Straits. A shallow-water species but apparently not typical of the tide-pool fauna, at least in its southern ranges extending down to a depth of 47 fathoms. *L. agassizii* is a common market fish in northern Japan, being taken by the fishermen with hook and line and with the seine. Thirty-two specimens examined.

Relationship.—In many respects *L. agassizii* resembles *L. tunicatus* and *L. herschelinus.* Besides being isolated geographically it can be distinguished from these two species by the larger gill opening, the increased number of pyloric coeca, and the coloration.

Description of No. 49827, U.S.N.M.—Dorsal 43; anal 34; pectoral 36; pyloric coeca 67. Depth 4.8 in length without caudal; head 3.5. Eye 7 in head; disk 2.4.

Body short and heavy anteriorly, tapering gradually to the caudal fin; flesh flabby. Head broad and heavy; occiput slightly swollen; width of head greater than depth of head; profile depressed over the eyes. Mouth broad; maxillary reaching vertical from posterior half of eye. Teeth rather small and slender, arranged in about 20 oblique rows in the half of each jaw, the lateral lobes well developed. Snout broadly rounded; upper jaw slightly projecting. Anterior nostril in a short tube; posterior nostril without tube. Eye small, the lower half

silvery. Gill slit extending down in front of nine pectoral rays. No prickles.

Origin of dorsal fin over gill flap; the rays increasing gradually in length. Caudal rounded; connected for nearly one-half its length to the dorsal fin, connected a little more than one-half its length to the anal fin; a shallow notch between the dorsal and the caudal. Pectoral notched; lower lobe of eight rays, reaching to nearly halfway between disk and vent.

Several types of coloration are exhibited by the specimens at hand: (1) Skin translucent, with a purplish or brownish cast; fins dusky; eye black. (2) Upper parts brownish; a series of white spots along the sides, these bordered with dark brown in front and behind; fins speckled and barred with brown; tips of rays whitish; eyes silvery. (3) Body brownish, blotched with crossbars on body and fins; short stripes radiating out from eye. (4) Brownish with purplish stripes extending from snout to base of caudal; eye silvery; peritoneum silvery with scattered black dots.

Synopsis.—Dorsal 42–43; anal 33–35; pectoral 34–39; plyoric coeca 64–90. Disk 2.1–2.7 in the head. Gill slit extending down in front of five to nine pectoral rays. Dorsal fin unnotched. Dorsal fin connected to the basal half of the caudal. No prickles. Color variable. A medium to large sized species, our largest specimen 161 mm. in length.

Remarks.—*L. agassizii* exhibits considerable variation in color and general appearance, but there is little difficulty in separating this species from all others from the same region. The gill slit varies considerably, extending down in front of from five to nine pectoral rays, the normal condition being in front of seven or eight rays. A shallow notch is usually present between the dorsal and the caudal fin.

LIPARIS DENNYI Jordan and Starks

Liparis dennyi Jordan and Starks, 1895, p. 835, pl. 98.—Jordan and Evermann, 1898, p. 2124, fig. 766.

Type.—Male, No. 3703, S. U. Z. M.; Admiralty Inlet, Puget Sound; Young Naturalists Society of Seattle.

Distribution.—Coasts of Washington and northward to the Gulf of Alaska; shallow waters down to 123 fathoms, rarely if ever found in the tide pools. One hundred specimens examined.

Relationships.—*L. dennyi* closely resembles *L. gibbus* of Bering Sea. It can be distinguished from the latter species by the smaller number of dorsal rays and sometimes by the presence of the dorsal notch. The adults of *L. dennyi* appear to have a less projecting snout and a deeper head than in *L. gibbus*. At present the regions inhabited by the two species appear to join but not overlap, the Alaska Peninsula serving as a barrier between the two.

Synopsis.—Dorsal 37–40; anal 31–34; pectoral 37–39; pyloric coeca 19–31. Posterior nostril apparently always with a fingerlike projection in front. Disk 2.2–2.4 in head. Gill slit extending down in front of from 10 to 15 pectoral rays. Dorsal fin notched or the anterior rays nearly equal in length. Dorsal fin connected to the basal two-fifths of the caudal. No prickles. Coloration variable. A medium-sized species, reaching a length of 198 mm.

Remarks.—The posterior nostril in this species apparently always has a fingerlike projection in front. The jaws are equal or nearly so; usually a few of the upper teeth are exposed when the jaws are closed. In the young the maxillary extends to beneath the middle of the pupil or beyond. Sometimes rudimentary pores, appearing as dark spots with white centers, extend backward from the suprabranchial pores.

Numbers of specimens from East Sound differ from the typical specimen of this species in the length of the lower pectoral lobe and the coloration. These specimens may represent an undescribed species though we can not at present decide this point. For the purposes of comparing these specimens with the typical specimens No. 4009, S. U. Z. M., we present the following:

In the East Sound specimens the lower lobe of the pectoral reaches the vent or beyond; in nearly all the specimens, No. 4009, S. U. Z. M., it does not reach the vent. These two groups of specimens differ also in the coloration. Of the specimens, No. 4009, one resembles the type in coloration; the remainder are plain olive brown or with narrow longitudinal white lines on head and body; the peritoneum silvery, undotted. The East Sound specimens present "Four different types of coloration: (1) Nearly plain dark brown with obscure dusky mottlings, the pectoral fin crossbarred with black and white; chin speckled, margin of median fins nearly black. (2) The entire upper parts, including the dorsal fin, marked with paralled wavy light streaks with darker margins, the intervals between the streaks dusky olive, pectoral more obscurely barred. (3) Entire upper parts dark olive, thickly covered with small white dots less than the diameter of the pupil. (4) Lighter olive, marked with few whitish or silvery white narrow streaks or bars, which are black margined. One series of these cross the dorsal fin, another the anal, both continued a variable distance on the body, sometimes meeting. Other streaks and spots occupying the top and sides of the head and may be symmetrically disposed on the two sides of the same individual, although not agreeing in different specimens." Caudal faintly or broadly barred, peritoneum silvery, dotted.

In this species the dorsal fin is notched in fully half the specimens. In specimens No. 60200, U.S.N.M., consisting of young individuals 20 to 28 mm. in length, the dorsal notch is some times evident. Some of these specimens, in which the notch was not evident, were dissected

and the sixth and seventh rays found to be shorter than the preceding rays. Two of these specimens showed pale stripes extending backward from the snout above and below the eye to the caudal. The remainder of these specimens were speckled with brown and the caudal broadly barred. Fully half the specimens No. 21314 S.U.Z.M., have the dorsal notch evident without dissection.

LIPARIS GIBBUS Bean

Liparis gibbus Bean, 1881*b*, p. 148.
Liparis agassizii, Jordan and Evermann, 1898, p. 2721, fig. 765 (part).—Evermann and Goldsborough, 1907, p. 333, fig. 101, (part).

Type.—Male, No. 24047, U.S.N.M.; St. Paul Island, Bering Sea. Length 68 mm.

Distribution.—St. Paul Island, Bering Sea, and coast of Siberia. Four specimens examined.

Relationship.—In the region extending from Washington northward through Bering Sea and southward through the Okhotsk and Japan Seas is a series of six closely related species of *Liparis*. Of these *L. dennyi* is found from the coast of Washington to the Gulf of Alaska, *L. gibbus* and *L. cyclostigma* in Bering Sea, *L. ochotensis* and *L. rhodosoma* in the Okhotsk Sea, and *L. ingens* in the Japan Sea.

The two Bering Sea species are not readily separated. I have recognized the two species as distinct. However, the slight differences between the types may be due to age. The three Japanese species appear to have a larger number of dorsal and anal rays and prickles.

Synopsis.—Dorsal 42–44; anal 35–36; pectoral 37–38; pyloric coeca 45. Posterior nostril apparently without a fingerlike projection in front. Upper jaw projecting. Eye moderate, 4 to 5.5 in head. Disk 2–2.3 in head. Gill slit extending down in front of 14 pectoral rays. Dorsal unnotched. Dorsal connected to caudal for nearly one-half the length of the latter. No prickles.

LIPARIS CYCLOSTIGMA Gilbert

Liparis cyclostigma Gilbert, 1896, p. 446, (part).
Cyclogaster cyclostigma Gilbert and Burke, 1912*a*, p. 73, fig. 18.

Type.—Male, No. 48621, U.S.N.M., vicinity of Bristol Bay, Bering Sea, *Albatross* Station 3252; depth 295 fathoms.

Distribution.—Bering Sea, *Albatross* Stations, 3252, 4777, 4779, 4789, 4795, 4796; depth 43 to 295 fathoms. Six specimens examined.

Relationships.—*L. cyclostigma* closely resembles *L. gibbus*. (See description of latter species.)

Synopsis.—Dorsal 40–44; anal 33–35; pectoral 39–43. Posterior nostril without projection. Disk 2.3 in head. Gill slit extending down in front of 12 to 14 pectoral rays. Dorsal connected to caudal for nearly one-half the length of the latter. No prickles. A large species reaching a length of 357 mm.

LIPARIS OCHOTENSIS Schmidt

Liparis ochotensis Schmidt, 1904*a*, p. 163.
Cyclogaster ochotensis Gilbert and Burke, 1912*b*, p. 359.

Types.—Male, No. 12963 and 12964, Museum of the Imperial Academy of Sciences, St. Petersburg. Saghalin Island.

Distribution.—Shallow waters about Saghalin Island, Okhotsk Sea, our specimens from Cape Terpenis and Anuva Bay, Saghalin; depth 21–43 fathoms. Six specimens examined.

Relationships.—*L. ochotensis* appears to be most closely related to *L. ingens*. It differs from the latter species in the characters of the teeth, equal jaws, and stouter body. It is readily distinguished from *L. agassizii* by the larger gill slit and smaller number of pyloric coeca. See descriptions of *L. gibbus*, and *L. rhodosoma* for comparisons with these species.

Description of type.—No. 12963, male, length 195 mm. Dorsal 45, anal 36; pectoral 39; pyloric coeca 25. Depth 3.5 in length without caudal; head 3.3. Disk 2.6 in head.

Body rather deep, dorsal outline sloping gradually. Head broad, depth greater than width; profile gradual, slightly depressed over the eyes; occiput not swollen. Mouth broad; maxillary reaching pupil. Teeth trilobed, recurved; the lateral lobes not so prominent on the larger teeth; in broad bands, arranged in about 17 oblique rows in the half of each jaw. Snout short, depressed; jaws nearly equal. Anterior nostril in a tube; posterior nostril with a prominent rim. Eye small, 6.1 in head. Gill slit extending down in front of 18 pectoral rays, equal to snout. A few minute prickles on head, these consisting of a small round base and a short thick conical spine.

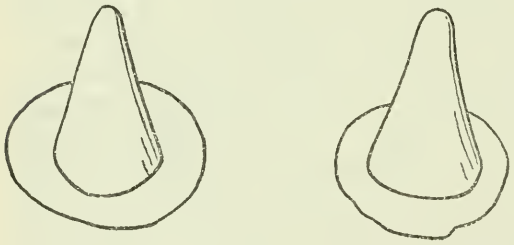

Figure 11.—Liparis ochotensis. Prickles from type

Dorsal fin high, the rays increasing in length to middle of fin or beyond, at this point 1.5 times the length of the snout. Anal resembling dorsal, the rays not quite so long. Caudal slightly rounded, connected for nearly one-half its length to the dorsal. Pectoral broad; the lower lobe of six rays, reaching three-fourths the distance from disk to vent. Disk large, with a broad flap. Vent separated from disk by nearly diameter of disk.

Color grayish; narrow, paired, dusky stripes on head, body, and base of dorsal; these sometimes united anteriorly to form single stripes; margin of dorsal and anal mottled and dusky; caudal mottled and barred with dusky markings; margin of pectoral dusky; peritoneum pale, with scattered dots.

Synopsis.—Dorsal 45; anal 36–38; pectoral 39–42; pyloric coeca 23–38; posterior nostril without a projection in front. Jaws about equal. Teeth not so slender or recurved as in *L. ingens*, arranged in 14–25 oblique rows in the half of each jaw, the number in upper and lower jaws about equal. Disk 2.5–2.6 in head. Gill slit extending down in front of from 12 to 18 pectoral rays. Dorsal fin unnotched. Dorsal connected to near the middle of the caudal. Prickles sometimes present. A large-sized species, reaching a length of 465 mm.

LIPARIS INGENS (Gilbert and Burke)

Cyclogaster ingens GILBERT and BURKE 1912*b*, p. 360.

Type.—Male, No. 73330, U.S.N.M.; *Albatross* Station 4863, southern part of the Japan Sea; depth 250 fathoms.

Relationships.—*L. ingens* appears to be most closely related to *L. ochotensis*. It can be distinguished by the teeth, the projecting upper

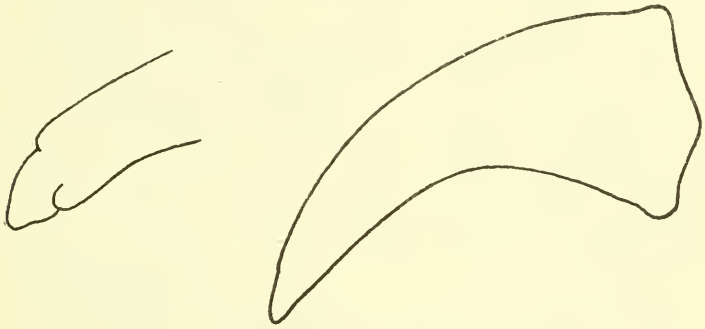

FIGURE 12.—LIPARIS INGENS. TEETH FROM TYPE

jaw, and the slenderer body. The coloration of the type is distinct but this character is a variable one among the species of *Liparis*.

Synopsis.—Dorsal 45; anal 37; pectoral 42; pyloric cocea 37. Posterior nostril without projection in front. Upper jaw projecting, exposing nearly all the upper band of teeth; about 20 oblique rows in the half of the lower and 30 in the half of the upper jaw; the inner teeth slender and strongly recurved. Gill slit extending down in front of 16 pectoral rays. Dorsal fin unnotched. Prickles present. A large-sized species, reaching a length of 485 mm.

LIPARIS RHODOSOMA, new species

Cyclogaster ochotensis GILBERT and BURKE, 1912*b*, p. 359 (part).

Type.—Male, No. 22271, S.U.Z.M. Okhotsk Sea, off Saghalin, *Albatross* Station No. 5023; depth 75 fathoms. Length 200 mm.

Distribution.—Southwestern part of the Okhotsk Sea off the coast of Saghalin, *Albatross* Stations 5016, 5017, 5020, 5021, and 5023; depth 64 to 75 fathoms. Five specimens examined.

Relationships.—*L. rhodosoma* resembles *L. ochotensis* in most respects, differing in the shape of the head and the coloration. These two species inhabit the same geographical region, but up to the present time all the specimens listed as *L. rhodosoma* are from greater depths than any of the specimens of *L. ochotensis*. It seems unlikely that *L. rhodosoma* represents a color phase of *L. ochotensis*.

Description of type.—Dorsal 45; anal 37; pectoral 41; pyloric coeca 37; depth of body 3.7; head 3.5. Eye 7 in head; disk 2.7.

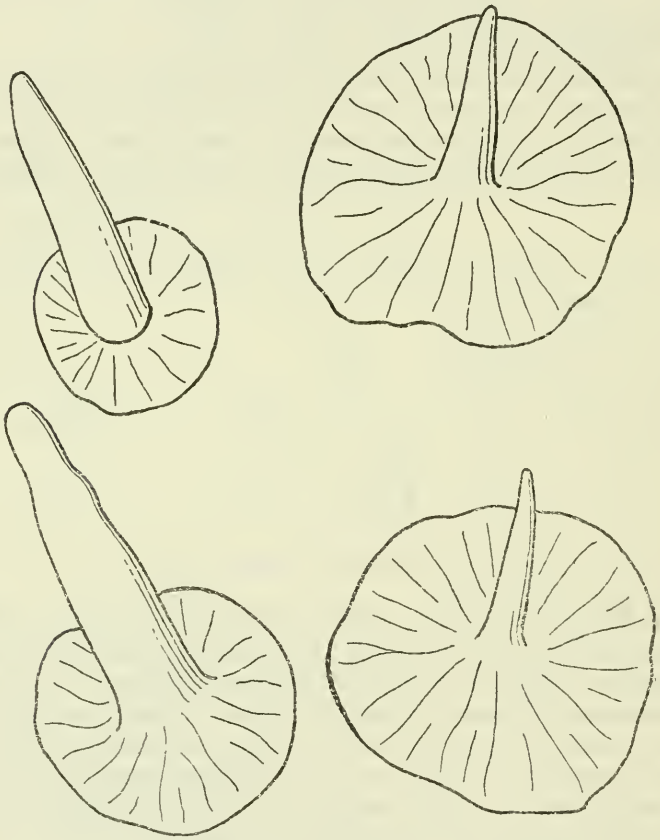

FIGURE 13.—LIPARIS INGENS. PRICKLES FROM TYPE

Body more elongate and tapering more gradually than is typical of the tide-pool species. Head distinctly pointed; profile rising gradually from snout to occiput, a slight depression over the eyes; sides of head sloping outward slightly; the cheeks little swollen. Mouth moderate; maxillary reaching vertical from middle of eye. Teeth with well-developed lateral lobes; the smaller teeth blunt but the lobes indicated; the larger teeth rather slender and recurved, with lateral lobes well developed; arranged in 17 oblique rows in the half

of the lower jaw, 20 in the half of the upper jaw. Snout overlapping the mouth for one-half the eye, not so pronounced in the young individual; upper teeth exposed when the jaws are closed. Eye small. Gill slit extending down in front of 15 pectoral rays. "Thumb-tack prickles" on top of head and body, extending back slightly beyond origin of dorsal; the spine slightly conical. Pyloric coeca 37.

Dorsal normal; the origin just back of the base of the pectoral; 12 or more rays unsegmented. Two anal rays unsegmented. Caudal slightly rounded; the dorsal and anal connection abrupt; a slight notch between the anal and the caudal, none between the dorsal and the caudal; anal connected to the caudal for more than one-half the length of the caudal; the dorsal connection less. Pectoral notched, the lower lobe reaching nearly to vent. Disk large, with a broad flap.

Color pinkish, slightly gelatinous, with a few faint roundish or irregular brown spots over body and fins; pectoral with faint bars; caudal with 2 bars near the base, 3 farther out, and 1 near the tip. Peritoneum white, undotted.

Synopsis.—Dorsal 45–46; anal 37; pectoral 40–42; pyloric coeca 33–44. Posterior nostril without projection in front. Upper jaw distinctly overlapping the lower jaw, upper teeth exposed when the jaws are closed. Disk 2.1–2.7 in head. Gill slit extending down in front of 14 to 15 pectoral rays. Dorsal fin unnotched. Dorsal connected to the caudal for about one-half of the length of the latter. Prickles sometimes present. A medium to large species, reaching a length of 200 mm.

Remarks.—In the young individual the snout does not project so far, thus bearing a closer resemblance to the typical *Liparis*. The smallest individual has 13 oblique rows of teeth in the half of each jaw. Color variable; the larger individuals more pinkish and gelatinous than the smaller ones. An individual 105 mm. long has the head and body covered with double dark-brown stripes which diverge posteriorly; dorsal and anal variegated with dusky markings and faint bars; caudal with two dark bars and several blotches. The adult specimens exhibit two types of coloration—(1) that described for the type, sometimes the markings more pronounced; (2) pale pinkish blotches with dark margins on top of head and sides of body, as follows: 4 on the dorsal and anal, extending on the sides of the body and nearly uniting at the median line; 1 extending back from gill opening, those on the head obscure; 1 extending from the occiput down onto the sides of the head; 1 running back from the lip through nostril and uniting across the top of the head with its mate. Prickles are absent in all but the type.

Table of measurements of Liparis rhodosoma

Locality—stations	5016	5021	5023	5017
Length	144	191	200	105
Depth of body	4. 3	4. 0	3. 7	4. 5
Snout to disk	7. 0	6. 6	7. 0	6. 5
Disk to anal	5. 9	6. 2	6. 0	5. 6
Depth, head	4. 7	4. 5	4. 2	5. 0
Width, head	4. 7	5. 0	4. 6	4. 8
Head	3. 6	3. 6	3. 5	3. 3
Eye in head	6. 0	6. 5	7. 0	5. 0
Snout	2. 3	2. 6	3. 0	2. 6
Internostril	3. 6	4. 2	4. 2	4. 5
Gill slit	2. 5	2. 3	2. 5	2. 7
Disk	2. 1	2. 5	2. 7	2. 6
Disk to vent	2. 3	2. 6	2. 7	2. 3
Pyloric coeca	44	39	37	33
Dorsal	45	45	45	46
Anal	37	37	37	37
Pectoral	7–35	8–34	8–33	7–33
Pectoral rays behind gill slit	14	15	15	14
Sex	Female.	Female.	Male.	Male.

Specimens examined

Specimen	Locality	Collector
1	Station 5016, Okhotsk Sea	Albatross, 1906.
1	Station 5017, Okhotsk Sea	Do.
1	Station 5020, Okhotsk Sea	Do.
1	Station 5021, Okhotsk Sea	Do.
Type 1	Station 5023, Okhotsk Sea	Do.

LIPARIS STEINENI Fischer

Liparis steineni Fischer, 1885, p. 63.—Garman, 1892, p. 66.
Enantioliparis steineni Gill, 1891, p. 365.
Cyclogaster steineni Burke, 1912*b*.

Types.—Two, No. 3945, Fisch sammlung Naturhistorischen Museum, Hamburg; Royal Bay, South Georgia.

Distribution.—Tide pools or shallow waters of South Georgia. Not seen by the writer.

Relationships.—The large disk and habitat suggest that Fischer is correct in placing this species in the genus *Liparis*. However, if the nostrils are correctly described it is a true *Careproctus*.

Synopsis.—Dorsal 44–45; anal 36; pectoral 32. Dorsal not notched. Disk 2 in head. Dorsal distinctly connected with the caudal. Pectoral unnotched. Only two specimens known, reaching a length of 70 mm.

LIPARIS ANTARCTICA Putnam

Liparis antarctica Putnam, 1873, p. 339.—Garman, 1892, p. 61, pl. 6, figs. 6–10.
Enantioliparis antarctica Gill, 1891, p. 365.

Type.—No. 12972, M. C. Z. Eden Harbor. Hassler Expedition, 1872. Length 32 mm.

Distribution.—Known only from the type locality, Eden Harbor, South America.

Relationships.—*L. antarctica* is widely divergent from any of the northern species. The distinctive characters are the small number of fin rays and coeca and the unnotched pectoral fin. *L. antarctica* and *L. liparis* have the least pyloric coeca of any of the species of *Liparis*. In the character of the unnotched pectoral fin *L. antarctica* agrees with *L. tanakae* and *L. owstoni* of Japan.

Description of type.—Dorsal 28; pyloric coeca 10; depth 3.6 in length without caudal; head 3.2. Eye 4 in the head; disk 1.9. Garman (1892) records the anal as with 24 and the pectoral with 30 rays.

Body short and heavy as in *L. callyodon*. Head deep; depth about equal to the width; occiput swollen as in the young of *L. dennyi;* cheeks slightly swollen. Mouth terminal with little lateral cleft; maxillary reaching beneath the front of the pupil. Teeth stout, strongly trilobed, in broad bands, arranged in oblique rows. Snout abrupt, not projecting, lower jaw included. Anterior nostril in a short tube; posterior nostril without tube. Eye black. Gill slit above the pectoral. No prickles. Pyloric coeca in a single row, about 10.

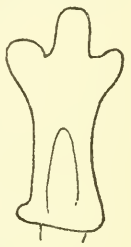

Figure 14.—Liparis antarctica. Tooth from type

Dorsal apparently without a notch. Caudal broad, connected for nearly one-half its length to the anal. Pectoral somewhat mutilated, apparently unnotched, possibly as figured. Disk large, round; snout to disk 8 in the length without caudal. Vent close to the disk. Color pale, brown to slate; peritoneum pale.

Synopsis.—Dorsal 28; anal 24?; pectoral 30?; pyloric coeca 30. Disk 1.9 in head. Gill slit above the pectoral fin. Dorsal fin unnotched. Dorsal connected to the caudal for nearly two-fifths of the length of the latter. Pectoral unnotched. A small-sized species.

LIPARIS TANAKAE (Gilbert and Burke)

Liparis owstoni Schmidt, 1904*a*, p. 189 (part, not of Jordan and Snyder).—Tanaka, 1908, p. 45, pl. 3, (part, not of Jordan and Snyder).
Cyclogaster tanakae Gilbert and Burke, 1912*b*, p. 357.

Type.—No. 21417, S. U. Z. M. Vries Island, Sagami Sea, Japan. Length 368 mm.

Distribution.—*L. tanakae* apparently exists in the Japan Sea and off the northeast coast of Hondo. I have examined specimens of the

species from Vries Island, Misaki, Shiogama, Oshima, Japan, and Tusan, Korea. Tanaka records a specimen from Ushitsu, Province

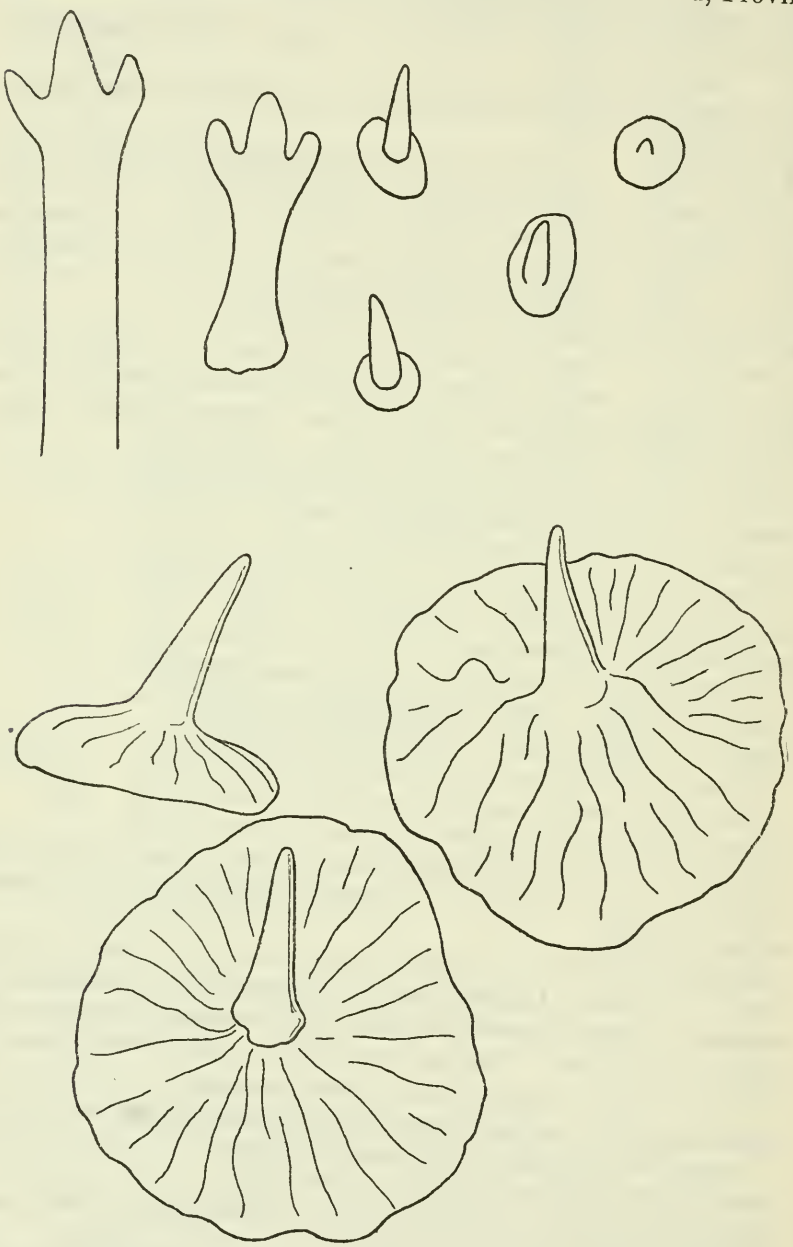

FIGURE 15.—LIPARIS TANAKAE. TEETH AND PRICKLES FROM TYPE

of Noto, and another from the Tokyo fish market. A specimen probably belonging to this species was obtained by Schmidt (1904,

recorded as *Liparis owstoni*) in the Nagaski fish market. Nine specimens examined.

Relationships.—*L. tanakae* agrees with *L. owstoni* in the broad connection between the dorsal and the caudal and in the unnotched pectoral. It probably represents an intermediate stage between *L. owstoni* and the typical *Liparis*. It is distinguished from *L. owstoni* by the broad, low, projecting snout, the broad head, and the coloration.

Synopsis.—Dorsal 41–45; anal 34–36; pectoral 40–42; pyloric coeca 55–62. Disk 2.5–2.7 in head. Gill slit extending down in front of 6 to 11 pectoral rays. Snout broad, low, projecting. Pectoral fin unnotched in the adult, possibly slightly notched in the young. Dorsal fin unnotched. Dorsal connected to more than the basal two-thirds of the caudal. A gigantic species, reaching a length of 430 mm.

Remarks.—Two specimens, collected by H. M. Smith at Shiogama, Matsushima Bay, present certain peculiarities. They are not fully grown and may not represent adult conditions but appear to belong to this species.

The smaller specimen (113 mm.) agrees with the type of *L. tanakae* in the shape of the body. The pectoral is slightly notched, when the fin is folded the seventh, eighth, and ninth rays slightly exceed the tenth, eleventh, and twelfth. Teeth arranged in about 15 rows in the half of each jaw. There is no white line on the caudal as in the type. The top of head and side of body with pale gray stripes separated by narrow brown stripes. Maxillary reaching middle of eye. Prickles absent, no pits in the skin.

The larger specimen (218 mm.) differs from the type of *L. tanakae* in a shorter snout and deeper nasal region. The body is shaped more like *L. owstoni*. The maxillary reaches the middle of the eye. Vent separated from disk by diameter of disk. The tenth, eleventh, twelfth thirteenth, and fourteenth pectoral rays ending at same level. Stripes on the body obscure. This specimen shows more resemblance to *L. owstoni* than does the smaller specimen but the wide head and projecting snout readily distinguish it from *L. owstoni*.

LIPARIS OWSTONI (Jordan and Snyder)

Trismegistus owstoni Jordan and Synder, 1904, p. 238, pl. 58.
Liparis owstoni Schmidt, 1904*b*, p. 189, figs. 1–2, (part, confused with *L. tanakae*).—Tanaka, 1908, (part, confused with *L. tanakae*).
Cyclogaster owstoni Gilbert and Burke 1912*b*, p. 358.

Type.—Male, No. 8385, S. U. Z. M., Enoshima, Sagami Bay, Japan. Length 429 mm.

Distribution.—Sagami Bay, from deep water. One specimen, the type examined.

Relationships.—*L. owstoni* differs from all the remaining species of *Liparis* in the peculiar shape of the head. It agrees with *L. tanakae*

in the broad connection between dorsal and caudal and the unnotched pectoral.

Synopsis.—Dorsal 43; anal 35; pectoral 40; pyloric coeca 50. Disk 2.3 in head. Snout very short, broad, blunt, in profile rounded, not

FIGURE 16.—LIPARIS OWSTONI, SHOWING THE MODIFIED HEAD, DIFFERING IN THIS RESPECT FROM THE TIDE POOL SPECIES

projecting. Gill slit extending down in front of 10 pectoral rays. Pectoral fin unnotched. Dorsal fin unnotched. Dorsal connected to more than the basal half of the caudal. A gigantic species, reaching a length of 429 mm.

Remarks.—The shape of the head and the anterior position of the disk agree with some species of *Careproctus*. The color of the dermis, being reddish violet, resembles that of *L. tanakae*, *L. ochotensis*, and *L. ingens*. Tanaka (1908) and Schmidt (1904) have confused this species with *L. tanakae*.

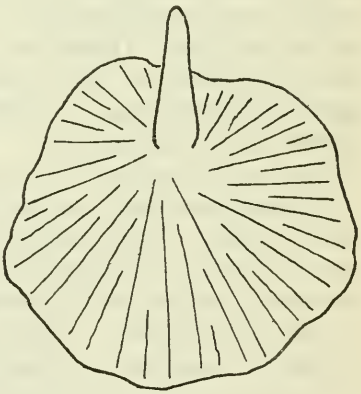

FIGURE 17.—LIPARIS OWSTONI. PRICKLE FROM TYPE

LIPARIS PULCHELLUS Ayres

Liparis pulchellus AYRES, 1855, vol. 1, p. 23.—GARMAN, 1892, p. 67, pl. 4, figs. 6–8. *Cyclogaster pulchellus*, GIRARD, 1858 p. 132.

Type.—Lost. San Francisco fish market.

Distribution.—A shallow-water species extending from San Francisco Bay to Bristol Bay, Alaska. Only one of our specimens is from Bristol Bay, and this record may be questioned. The species certainly is not common in Bering Sea.

Relationship.—*L. pulchellus* can be distinguished from all other American species by the extremely long connection between the dorsal and the caudal. It appears to be allied to *L. tessellatus* of Japan. It can be distinguished from the latter species by the much smaller gill slit. Fifty-nine specimens examined.

Description.—A specimen from Point Reyes, Calif. Dorsal 48; anal 39; pectoral 37; pyloric coeca 32. Depth 4.6; head 5.6.

Body soft, thick, and elongate. Head broad, flat, and blunt; occiput not swollen. Mouth broad; maxillary reaching vertical from front of pupil. Teeth short, strong, slightly recurved, strongly trilobed, widely spaced, about 12 rows in the half of each jaw, the teeth in front appearing little smaller than those behind. Snout broad, bluntly rounded; jaws equal or the upper slightly projecting. Gill slit either above the pectoral or extending down in front of one to four rays, more distinctly down in front of the fin in adults. Prickles absent.

Dorsal normal, the rays increasing gradually in length. Caudal slender, connected to dorsal and anal for nearly its whole length, the connection gradual, not abrupt as in nearly all the other species of *Liparis*. Pectoral notched; the lower lobe reaching halfway between disk and vent. Disk large, 2.4 in head. Vent about midway between disk and anal, separated from disk by more than diameter of disk.

Color light brown. Other specimens have the upper surfaces of head and body covered with narrow, wavy lines; lower parts white; in others dark spots and vermiculations replace the lines; vertical fins dusky; dorsal and anal with longitudinal stripes and mottlings; pectoral with crossbars; peritoneum silvery with dark dots.

Synopsis.—Dorsal 48; anal 39; pectoral 37; pyloric coeca 32; disk 2.4 in head. Gill slit either above the fin or extending down in front of one to four pectoral rays. Dorsal fin unnotched; dorsal connected to near the tip of the caudal, the connection gradual and obscure. No prickles. A small to medium sized species, reaching a length of 123 mm. or more.

LIPARIS TESSELLATUS (Gilbert and Burke)

Cyclogaster tessellatus Gilbert and Burke, 1912*b*, p. 355.

Type.—Male, No. 73328, U.S.N.M.; south coast of Hokkaido, *Albatross* Station 5042; depth 61 fathoms.

Distribution.—South coast of Hokkaido to coast of Korea, Sea of Japan, *Albatross* Stations 4867, 5041, and 5042; depth 61–150 fathoms. Ten specimens examined.

Relationships.—*L. tessellatus* resembles *L. pulchellus* in the extreme connection between the dorsal, anal, and caudal fins, and in the number of fin rays. It can be distinguished from *L. pulchellus* by the much wider gill slit and the more pointed and compressed head.

Synopsis.—Dorsal 46–48; anal 37–38; pectoral 35–38; pyloric coeca 27–32. Disk 3–3.2 in head. Gill slit extending down in front of 16 to 17 pectoral rays. Dorsal fin unnotched. Dorsal connected to near the tip of the caudal, the two fins appearing almost continuous

as in *L. pulchellus*. A small to medium sized species, reaching a length of 187 mm.

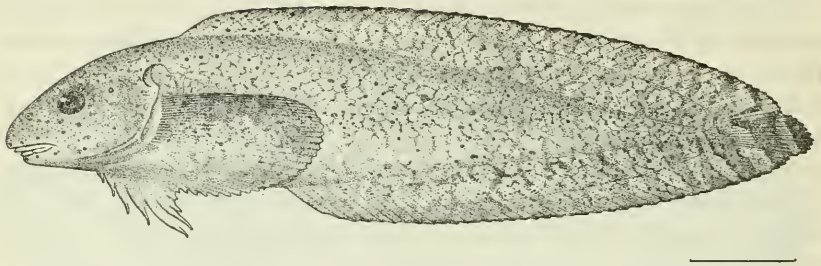

FIGURE 18.—LIPARIS TESSELLATUS. TYPE. A SPECIES THAT IN RESPECT TO THE UNNOTCHED DORSAL, UNION OF DORSAL, ANAL, AND CAUDAL AND IN APPEARANCE APPROACHES THE CAREPROCTUS TYPE

Remarks.—In specimens less than 135 mm. in length the head is not so pointed and the snout does not project so for beyond the lower jaw.

LIPARIS MAJOR (Gill)

Cyclopterus liparis major FABRICIUS, 1780, p. 136.
Actinochir major GILL, 1864, p. 193; 1873, p. 193.
Liparis fabricii LÜTKEN, 1886.—GÜNTHER, 1887, p. 66.—GILL, 1891, p. 376, pl. 29.
Careproctus major GARMAN, 1892, p. 72
Cyclogaster fabricii LÖNNBERG, 1899, (part).

Distribution.—Greenland and the Arctic Ocean to the eastward, probably circumpolar. Recorded by Lütken to range in depth from 46 to 106 fathoms, by Lönnberg from 14 to 140 meters. Ten specimens examined.

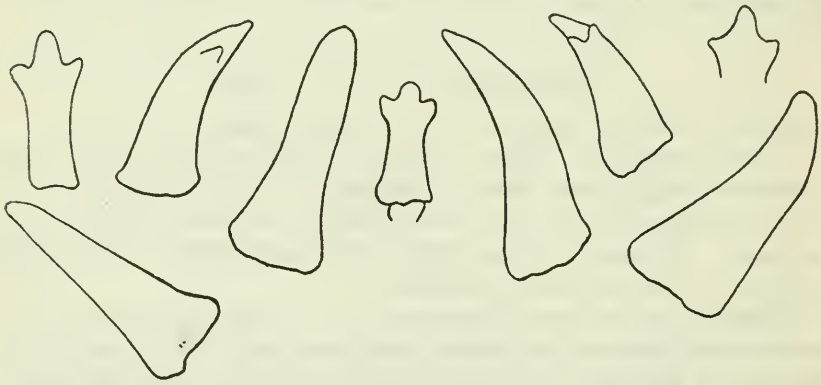

FIGURE 19.—LIPARIS MAJOR. TEETH FROM SEVERAL SPECIMENS

Relationships.—*L. major* is not closely related to any other known species. In the appearance of the heavy head and body this species somewhat resembles *L. megacephalus* though the head is much narrower. *L. major* differs from all the other species of *Liparis* in

the dark peritoneum and the dentition, the teeth being simple or weakly trilobed.

Description.—Body deep at union with head, short, tapering rapidly to caudal, much compressed. Head very heavy, flat between the eyes, profile sloping rapidly to snout, cheeks nearly vertical. Mouth wide, the lateral cleft extending to vertical from middle of eye; maxillary reaching beyond orbit. Teeth arranged in about 13 oblique, widely spaced rows in the half of each jaw; inner teeth much larger, slender, recurved, simple, or with the lateral lobes but faintly indicated; smaller teeth trilobed. Snout short, deep, rising abruptly; jaws equal. Anterior nostril in a short tube; posterior nostril reduced to a small pore. Eye large and prominent. Gill slit large, extending down in front of 10 pectoral rays, the flap broad. No prickles on any of the specimens examined. (See Lütken, (1886), for presence of prickles in this species.) Pyloric coeca reduced in number, about 20. Pores 2–6–7–2; rudimentary pores on the sides.

Dorsal rather high, the origin far forward, in front of the base of the pectoral. Anal connected to more than the basal half of the caudal; the dorsal connected to slightly less than the basal half of the caudal; the connection between the fins abrupt, sometimes a notch present. Pectoral deeply notched, the upper edge on a level with the lower margin of the eye; the lower lobe of six rays, reaching vent. Disk large, with a narrow flap. Vent midway between disk and anal, separated from disk by two-thirds diameter of disk.

Color a uniform dull slaty brown or the skin translucent and dusted with fine brown dots, these forming dusky streaks along base of dorsal; muscles puntulate; peritoneum pure black or heavily pigmented, differing in this respect from all other species of *Liparis*; stomach and ovary dusky, gill lining speckled.

Synopsis.—Dorsal 48; anal 40; pectoral 35; pyloric coeca 20. Disk 2.7 in head. Gill slit extending down in front of nine pectoral rays. Dorsal fin unnotched. Dorsal connected to slightly less than the basal half of the caudal. Prickles present or absent. Peritoneum black or heavily pigmented. Reaching a length of 144 mm. or more.

Remarks.—This species resembles members of the genus *Careproctus* in the large head, deep body, simple teeth, large eye, the color of the peritoneum, the reduced number of pyloric coeca, the comparative number of pectoral rays, and the reduced posterior nostril.

Genus POLYPERA Burke

Neoliparis Jordan and Starks 1895, (*greeni*).
Polypera Burke, 1912*a*, (*greeni*).

Disk large; dorsal fin notched; nostrils 2; teeth weakly trilobed and simple; pyloric coeca numerous, more than 200; branchiostegals, 6.

The genus *Polypera* differs from *Liparis* solely in the number of pyloric coeca. None of the 30 species of the latter genus has as many as 100 pyloric coeca. The pyloric coeca in *Polypera* are matted closely together and can be distinguished without counting from those of any of the species of *Liparis*. The dentition in *Polypera* is distinct from that found in any of the species of *Liparis* in which the dorsal fin is notched. The larger teeth in *Polypera greeni* are simple or have the lateral lobes but faintly indicated. The nearest approach to this type of dentition found amoung the species of *Liparis* is in *Liparis major* (Gill). In the latter species some of the larger teeth are simple, but in other characters the species is so widely divergent from *Polypera greeni* that we are led to believe that the similarity in dentition is due to parallel development.

KEY TO SPECIES OF POLYPERA

A¹. Dorsal 40 or less; anal 30 or less; pectoral 37.
  B¹. Color pale gray; gill opening above the pectoral or in front of the upper ray. P. beringianus.
  B². Color light brown with the epidermis removed; gill slit either above the pectoral or in front of one to four rays. P. greeni.
A². Dorsal 44; anal 34; pectoral 40. P. simushirae.

POLYPERA GREENI (Jordan and Starks)

Neoliparis greeni Jordan and Starks, 1895, p. 829, pl. 96.—Jordan and Evermann, 1898, p. 2112, fig. 763.
Liparis tunicatus Bean and Bean, 1896*a*, p. 243.
Liparis callyodon Bean and Bean, 1896*a*, p. 243 (part, No. 47561).
Liparis hercshelinus Jordan and Gilbert, 1899, p. 476 (part.).

Type.—Female, No. 3019, S. U. Z. M. Victoria Harbor, British Columbia. Length 244 mm.

Distribution.—Apparently extending northward from British Columbia to the Aleutian Islands. The specimen from Bering Island appears to belong to this species. Depth unknown; the type was dredged in Victoria Harbor, and the records of the Bering Island specimens are incomplete. Four specimens examined.

Relationships.—The three species of *Polypero* recognized in this work appear to be very closely allied and I am not certain that all three species should be recognized. More material must be obtained before we can demonstrate the validity of all three species. *P. simushirae* is based upon a single specimen. The horizontal distribution of *P. greeni* and *P. beringianus* is practically identical; it is possible that the vertical distribution of the two species may differ. *P. greeni* appears to come from deeper water than either *P. beringianus* or *P. simushirae*. As *P. beringianus* is known only from small specimens it is possible that it may represent the young of either of the other species. We will indicate here the apparent differences between the three species. *P. beringianus* has a paler coloration and

perhaps a smaller gill slit than *P. greeni*. *P. simushirae* appears to differ from *P. greeni* solely in the larger number of fin rays. *P. beringinaus* differs from *P. simushirae in* the lighter coloration, smaller gill slit and the smaller number of fin rays. Minor differences in the preportional measurements appear to exist.

Synopsis.—Dorsal 37–40; anal 31–32; pectoral 33–37; pyloric coeca more than 200. Disk 2.3–2.8 in the head. Gill slit typically extending down in front of 1 to 4 pectoral rays, sometimes appearing to be above the fin. Teeth simple and trilobed, elongate, recurved. Dorsal fin deeply notched, connected to less than the basal fifth of the caudal fin. Color a light brown. A large species, reaching a length of 244 mm.

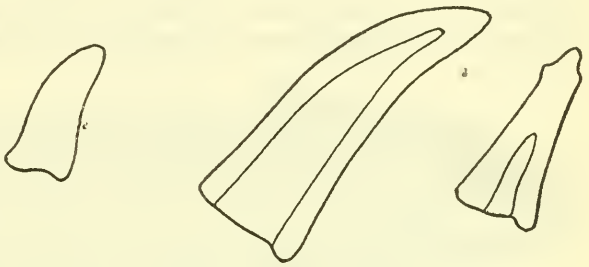

FIGURE 20.—POLYPERA GREENI. TEETH FROM TYPE

Remarks.—The Bering Island specimens differ in certain respects from the type as will be seen by the following notes on these specimens. Head wider than deep; cheeks swollen. Maxillary reaching posterior margin of eye. Snout somewhat depressed, the upper jaw slightly overlapping. Greatest depth of body at front of first dorsal. The gill slit is either above the pectoral or extending down in front of one or two rays. Vent separated from the disk by less than the diameter of the disk. Origin of dorsal above middle of pectoral and midway between the disk and vent. A shallow notch between the dorsal and caudal fins is present in the large specimens as figured in the type, absent in the smaller specimen. The two large specimens colored a soft brown as the type. The smallest specimen faded out to an ashy brown. Peritoneum pale with scattered dots.

POLYPERA BERINGIANUS (Gilbert and Burke)

Liparis callyodon STARKS, 1911, p. 196.
Cyclogaster beringianus GILBERT and BURKE, 1912*a*, p. 72.

Type.—Female, No. 74380 U.S.N.M.; Nikolski, Bering Island, *Albatross*, 1906; tide pools. Length 65 mm.

Distribution.—Aleutian Islands and southward to Port Townsend, Wash. The specimens examined are from Bering Island; Medni Island; Agattu Island; Unalaska; Kodiak Island; and Port Townsend, Wash. A tide-pool species. Thirty-four specimens examined.

Relationships.—*P. beringianus* closely resembles *P. greeni* and *P. simushirae*. A discussion of the relationships of these three species is given under *P. greeni*.

Synopsis.—Dorsal 38–39; anal 31–32; pectoral 36–37; pyloric coeca more than 200. Disk 2.4–2.9 in the head. Gill slit typically above the pectoral fin, sometimes appearing to extend down in front of the upper ray. Teeth as in *P. greeni* or the lateral lobes appearing somewhat stronger. Dorsal fin notched, barely connected to the caudal. Color pale gray. A small sized species, reaching a length of 126 mm.

Remarks.—In this species the depth of the body decreases very gradually, or remains the same from the first dorsal to well under the

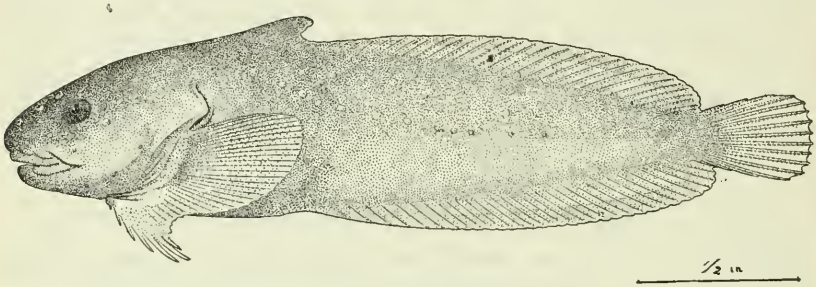

FIGURE 21.—POLYPERA BERINGIANUS. TYPE

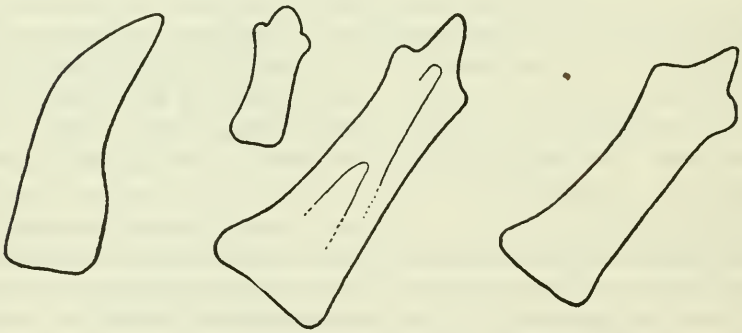

FIGURE 22.—POLYPERA BERINGIANUS. TEETH FROM TYPE

second dorsal. The gill slit is either above the pectoral or the upper pectoral ray points at a slight angle downward directly at the lower edge of the gill slit. In some specimens there are shallow notches between the caudal and the dorsal and anal.

POLYPERA SIMUSHIRAE (Gilbert and Burke)

Cyclogaster simushirae GILBERT and BURKE, 1912*b*, p. 354.

Type.—Male, No. 73327, U.S.N.M.; Milne Bay, Simushir Island, Japan, *Albatross*, 1906; tide pools. Length 138 mm.

Distribution.—Known only from the type specimen. A tide pool species. Type examined.

Relationships.—*P. simushirae* is closely allied to *P. greeni* and *P. beringianus*. An account of the differences between these three species is given in the discussion of *P. greeni*.

Synopsis.—Dorsal 44; anal 34; pectoral 40; pyloric coeca about 300. Disk 2.7 in the head. Dentition resembling that in *P. greeni* and *P.*

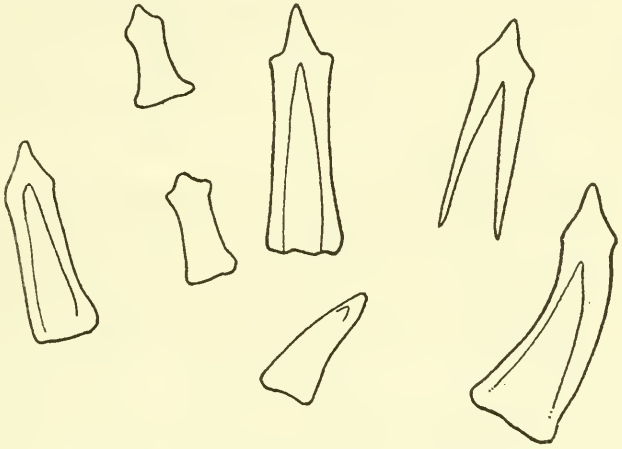

FIGURE 23.—POLYPERA SIMUSHIRAE. TEETH FROM TYPE

beringianus. Dorsal fin notched, connected slightly with the caudal. Color olive brown. Reaching a length of 138 mm.

Genus CAREPROCTUS (Kroyer)

Careproctus KROYER, 1862, p. 252, (*reinhardi*).
Enantioliparis VAILLANT, 1888*b*, p. 22, (*pallidus*).
Caremitra JORDAN and EVERMANN, 1896, p. 452, (*simus*).
Bathyphasma GILBERT, 1896, p. 442, (*ovigerum*).
Allochir JORDAN and EVERMANN, 1896, p. 452, (*melanurus*).
Allurus JORDAN and EVERMANN, 1896, p. 452 (*ectenes*); 1898, p. 2136, (*ectenes*).
Allinectis JORDAN and EVERMANN, 1898, p. 2866, (*ectenes*).
Prognurus JORDAN and GILBERT, 1899, Fur Seal Rept., pt. 3, p. 478 (*cypselurus*).

Disk present, perfect, nostril single; teeth trilobed to simple; suprabranchial pores usually 2; dorsal notch present or absent; pyloric coeca present or absent; pseudobranchiae absent; branchiostegals 6.

MODIFICATION OF CHARACTERS

Body.—The body varies from firm, short, stout, and depressed, as in *C. pycnosoma*, to the gelatinous, elongate, and compressed species typical of the genus. Many of the species have the body compressed and deepened in sharp contrast to the condition typical of the species of *Liparis*.

Head.—The head of the species of this genus is typically compressed, the depth being greater than the width. We should note that the

reverse is true of the majority of the species of *Liparis*. An exception to the typical compressed head is found in *Careproctus curilanus* in which species the width of the head is greater than the depth, the cheeks slope outward, and the snout is depressed and ends in a shovel-like projection. The cheeks are typically vertical and the snout short. The profile of the snout may rise gradually or abruptly from the upper lip. The mouth is always horizontal. The interorbital region may be quite narrow, as in *C. segaliensis*, or broad and flat, as in the spectrum group of species. Of the above characters the depth of the head and the shape of the snout can be the most readily utilized in separating species.

Nostril.—The posterior nostril is never present in this genus. The anterior nostril typically projects above the surface of the head. In some of the species, as in *C. bathycoetus*, the nostril tube hardly projects and is less prominent than the posterior nostril in some species of *Liparis*. The posterior margin of the tube is sometimes raised into a projecting flap, as in *Careproctus pycnosoma*. The position of the nostril opening varies in its relation to the eye, depending to some extent upon the shape of the head. It may be above the front of the eye or directly in front of the pupil. The writer failed to make any practical use of the character presented by the nostril. This was partially due to the fact that in these fishes the nasal region is frequently collapsed in preserved specimens.

Eye.—The eye in the species of *Careproctus* is typically larger and more prominent than in the species of *Liparis*. It is usually contained from three to five times in the head. In the giant species, such as *C. colletti*, the eye does not appear especially prominent. The pupil is round or slightly oval. The pupil varies from being reduced almost to a point, as in *C. entargyreus*, to enlarged and comprising the major part of the eye. All of this variation can not be due to contraction and expansion of the iris. The color of the eye ranges from black to silvery. In many species, as in *C. spectrum*, the upper half of the eye is black and the lower half silvery. The silvery pigment frequently disappears in preserved specimens. The size of the eye and pupil and the coloration of the eye can be utilized in distinguishing certain of the species.

Pores.—The pores are frequently difficult to study on account of the condition of the skin. In some of the species the pore formula could not be made out. The pore formula 2–6–7–2 appears to be constant for the majority of the species of the genus. In *C. sinensis* and *C. segaliensis*, however, the pore formula is modified to 2–5–6–1. This may be true of other species in which the pores could not be studied. The position of the pores varies among the species. The suprabranchial pores may be closed together or widely separated. The posterior pore in *C. trachysoma* is rudimentary. The upper

pore on the snout may be high up and nearly between the nostrils, as in *C. pellucidus* and *C. trachysoma*, or far forward on the snout near the anterior pores, as in *C. bathycoetus* and *C. roseofuscus*. In some of the species the maxillary and mandibular pores are sunken in pits. In *C. sinensis* and a few other species the anterior mandibular pores have a common opening. In *C. bathycoetus*, a black species, the pores appear as white dots. A more extensive study of the pores is desirable as they will probably be found to be of considerable taxonomic importance.

Many of the species of *Careproctus* as of *Liparis* have rudimentary pores on the sides of the body and on the nape. These pores could not be detected on many of the species with a thin, lax skin and are probably absent. They are the most readily seen on the generalized species *C. pycnosoma*, *C. curilanus*, and *C. bowersianus*.

Gill slit.—In the majority of the species of *Careproctus* the gill slit is confined to the region above the base of the pectoral. For this reason the gill slit is not of such taxonomic importance as in *Liparis*. In the latter genus the gill slit, in the majority of the species, extends down in front of the pectoral and varies greatly in size. The variation in the size of the gill slit, when confined to the region above the base of the pectoral fin, is so slight as not to be of taxonomic value.

The extreme variation in the gill slit is almost as great as in *Liparis*. In *C. ostentum* the gill slit extends down in front of 14 pectoral rays. The gill membranes are frequently torn so that it is difficult to decide whether the slit is confined to the region above or extends down in front of the fin. The variation within some species is such that the gill slit in some specimens is above the pectoral fin and in other specimens extends down in front of the upper one or two rays.

Teeth.—The teeth may be either trilobed or simple. In some of the species both kinds of teeth are present. The teeth do not present any characters of generic value. We can roughly divide the genus into three groups of species based on the character of the teeth but these groups grade insensibly into each other. These three groups may be defined thus: (1) Teeth strongly trilobed; (2) teeth weakly trilobed to simple; (3) teeth simple, lanceolated, recurved, the anterior teeth appearing as large as the inner teeth.

The arrangement of the teeth on the jaw varies among the different species. They are always arranged in oblique rows. The inwardly diverging rows are, in some of the species with simple teeth, very oblique and difficult to count. In such species the band of teeth is usually narrow. A good example of this type of dentition is found in *C. gilberti*. The cutting surfaces presented by the bands of teeth are typically oblique. This is because the anterior teeth are smaller and placed lower on the outer surfaces of the jaw bones. A striking exception to this type of dentition is found in *C. colletti* and related

species. In these species the cutting surfaces of the bands of teeth appear horizontal when the jaws are opened. This is because the anterior teeth are not so much smaller than the inner teeth and not placed so low on the jaw bones as among other species. Also the inner teeth are recurved which helps to flatten the cutting surfaces of the bands of teeth.

The characters of the teeth are of little or no practical use in separating closely related species but are of considerable value in indicating the general relationships of the species.

Dorsal fin.—The rays of the dorsal fin are difficult to count on account of the delicate nature of these fishes. The rays appear as delicate threads in the fin tissue. The writer found the most satisfactory method for counting the fin rays to be to place the specimen on a piece of glass or the dissecting microscope, slit the fin membrane at the margin of the fin and fold it back on the body, and, with a pair of hooked needles, separate the rays as they are counted. It is sometimes an advantage with very delicate specimens to place them in a glass vessel, cover with alcohol, and examine under the simple microscope, the light being properly controlled from below.

The number of dorsal rays ranges from about 40 to 60. On account of the difficulty of making accurate counts of the number of dorsal or anal rays it has not been considered advisable to depend upon the number of these rays to separate species. With the study of more material (many of the species are represented by a single specimen), it will be possible to determine the number and amount of variation of the dorsal and anal fin rays. Then it will probably be found that the number of rays will serve as an index to many of the species.

The origin of the dorsal varies slightly but can not be used to advantage in distinguishing species at the present time. The length of the first dorsal ray, as compared with the diameter of the eye, serves to separate some of the species. This is a character which deserves further investigation. In *C. pycnosoma* the anterior dorsal rays are rather stiff and project distinctly. This condition is characteristic of the species of *Liparis*. In many of the species the anterior dorsal rays are buried in pseudotissue and do not come in contact with the fin membrane. They can be seen only by dissecting the fin. In such fins the anterior rays extend undulatingly backward.

The dorsal notch is absent or but faintly indicated in this genus. Two species, *C. attenuatus* and *C. pycnosoma*, appear to have the dorsal notch persisting. In the specimens known the fourth, fifth, and sixth rays appear slightly shorter than the preceding one.

The anterior rays are unsegmented but appear to be divided longitudinally and thus differ from the condition of the anterior rays in the species of *Liparis*. The following table indicates the species in which

the segmentation of the anterior dorsal and anal fin rays was investigated and the number of unsegmented rays in each fin.

Species	Dorsal fin	Anal fin
gilberti	15	7
Do	12	6
melanurus	9	3
sinensis	15	3
ranula	14	4
mirabilis	(?)	12

The connection between the dorsal and caudal is nearly constant for the genus and is typically less then one-half the length of the caudal.

Anal fin.—The number of anal rays varies from 32 to 57. What has been said concerning the taxonomic value of the number of dorsal rays applies equally well to the number of anal rays. It is doubtful if the number of dorsal or anal rays for the species varies more than six or seven. The number of anal rays in a species is always less than the number of dorsal rays and, with a few exceptions, in which the numbers are equal, greater than the number of pectoral rays. In *Liparis* the pectoral typically has a greater number of rays than the anal. A few of the anterior anal rays are unsegmented. The connection between the anal and caudal varies from three to six tenths of the length of the latter but is of little taxonomic value.

Caudal fin.—The number of caudal rays varies from 6 to 12 but is typically 8 or 10. There are few or no rudimentary rays at the base of the caudal. All the rays typically enter into the body of the fin. The variation of the number of caudal rays within a species has not been studied, and until this is done we can not utilize the number of rays in separating species.

The caudal is typically truncate or slightly rounded. An exception is found in *C. furcellus*, in which the caudal is slightly forked, and in *C. cypselurus*, in which it is deeply forked.

Pectoral fin.—The pectoral presents a number of important characters. The number of rays, the extent of the pectoral notch, and the length of the pectoral fin, especially of the lower lobe, can be utilized to a considerable extent in distinguishing the species.

The number of pectoral rays varies from 21 to 37. The number of rays for any one species apparently does not vary more than four or five. The pectoral shows the greatest reduction in the more specialized members of the genus. In *Liparis*, as we have already noted, the number of pectoral rays, typically exceeds the number of anal rays. In *Careproctus* the change has been in the opposite direction and the pectoral typically has a smaller number of rays than the anal fin.

The pectoral notch may be absent or extend nearly to the base of the fin. In *C. furcellus* the notch is absent or hardly discernible and in *C. cypselurus* very shallow. It is typically distinct, however.

In only one species, *C. longifilis*, are the middle pectoral rays rudimentary. In this species the notch extends nearly to the base of the fin.

The length of the lower pectoral lobe varies considerably among the different species but is quite constant for any one species and is of considerable taxonomic importance. It apparently varies but slightly with age. In *C. abbreviatus* the lower pectoral lobe is contained two or more times in the head, and in *C. rhodomelas* and *C. colletti* it exceeds the length of the head, and in *C. longifilis* is greatly elongate, extending past the middle of the body. The rays of the lower lobe are graduated in length and partly free. In *C. colletti* the rays are free nearly to the base. In none of the species of the genus, however, do they become as free as in some species of *Paraliparis*. The tips of the rays are sometimes coiled or wavy.

The upper edge of the pectoral fin remains at about the same level on the side of the body throughout the genus.

Disk.—The ventral disk becomes greatly modified both in size and shape in this genus. Its position also changes and the measurement "snout to disk" is of considerable importance. In the more generalized species the disk is large and oval or round and in every respect resembles the disk in *Liparis*. As we examine some of the more specialized species we find the disk becoming smaller. In *C. gilberti* it is contained seven to nine times in the head, and in *C. ostentum* it has become minute but remains perfect in structure.

With the reduction in size the disk becomes triangular and cupped. The triangular shape is caused by the margin posteriorly and on the sides anteriorly folding over the center. When the whole margin is folded over the center the disk is cupped. Whether or not the triangular shape always precedes the cupped condition is uncertain. The width of the margin is greatly reduced in some species. Examples of a triangular disk can be seen on *C. rhodomelas* and *C. longipinnis* and of a cupped disk on *C. abbreviatus*, *C. colletti*, *C. bathycoetus*, and others. In *C. rhodomelas* the margin of the disk is very narrow.

The above enumerated characters of the disk are of considerable taxonomic importance. The size and shape of the disk vary somewhat within a species but in general they aid in distinguishing many of the species.

Vent.—The vent is typically close behind the disk and the distance between the two varies little in the majority of the species. There are three species in which the vent is some distance from the disk. In *C. attenuatus* and *C. pycnosoma* the vent is about midway between the disk and margin of the anal fin and in *C. opisthotremus* it is nearer the anal fin than the disk.

Pseudobranchiae.—Pseudobranchiae are absent from many if not from all the species of the genus. The following species were found to lack pseudobranchiae: *gilberti, melanurus, cypselurus, bowersianus, col-*

letti, and *spectrum*. It is possible that pseudobranchiae may be present in the more generalized species of the genus.

Pyloric coeca.—The number of pyloric coeca varies from 0 to 45. The majority of the species have less than 20. This is quite a reduction from the number found in *Liparis* in which genus the number varies from 10 to more than 90 and only 2 or 3 of the species have less than 20. On account of the scarcity of material the taxonomic value of the number of pyloric coeca has not been investigated. The coeca in this genus became shifted over the left side of the abdominal cavity due to a shortening of the alimentary tract. They are more readily reached through an incision on the left side of the body.

Prickles.—Two distinct types of prickles, the "thumb-tack" and cactuslike, are present on some of the species of *Careproctus*. Only two species—*C. entomelas* and *C. entargyreus*—are known to have "thumb-tack" prickles. It is very likely that other species, possibly known ones, will be found to have this type of prickle. Four species—*C. ostentum*, *C. rastrinus*, *C. trachysoma*, and *C. acanthodes*—are known to possess cactuslike prickles. The significance of these prickles is unknown. Whether or not they are of specific value remains to be investigated. They are present on only one of the specimens of *C. ostentum* but are present on all the specimens of the other three species. They are easily rubbed off with the epidermis.

Coloration.—The species of *Careproctus* are never variegated, mottled, barred, or striped as is typical of the species of *Liparis*. The species of *Careproctus* are uniformly colored whitish, pinkish, dusky, or black, or a combination of these colors, but never in such a manner as to be variegated. White and pink predominate in the shallower water forms and black in the greater depths. *C. pycnosoma*, one of the most generalized species of the genus, has a uniform dusky gray color like a few species of *Liparis*. The peritoneum varies from silvery to dotted and pure black. The stomach varies from pale to black. It varies independently of the peritoneum and may be black when the peritoneum is pale or pale when the peritoneum is black. The peritoneum is white or black, but apparently is never white or silvery when the epidermis is black. The color of the mouth and gill cavity varies from pale to black. When the skin is transparent the flesh is usually stippled with black. The black pigment apparently encroaches first upon the caudal region, peritoneum, gill cavity, and mouth. These regions are frequently black when the remainder of the body is light colored. All intermediate stages from white to pure black are found in the genus. Rarely, if, ever is there more pigment in the dermis anteriorly than posteriorly. The genus represents the transition from the hemibathybial to the bathybial type of coloration; *Liparis* represents the littoral type.

The specific coloration appears to be quite constant and of considerable taxonomic importance. We have hardly enough material to draw any definite conclusions concerning the color variation within the species. A few examples will suffice to indicate both our lack of knowledge concerning the variability of coloration in these fishes and the possible importance of the color in distinguishing species. *C. spectrum* and *C. gilberti* resemble each other closely and formerly have been confused. Their coloration differs, however, for in *C.* spectrum the stomach is always white and in *C. gilberti* blackish. The difference in the color of the stomach is supplemented by anatomical differences which have formerly been overlooked. *C. spectrum* and *C. melanurus* are closely related species. The former differs from the latter in having less pigment in the mouth, gill cavity, peritoneum, and the posterior part of the body. The two species differ also in distribution; they inhabit neighboring regions. In some of the specimens of *C. melanurus* the peritoneum has little more pigment than is typical of the species *C. spectrum*. *C. cypselurus* varies somewhat in coloration. The posterior part of the body is always black, but the anterior part varies from whitish to purplish black. *C. entomelas* and *C. entargyreus* were thought at first to differ solely in the amount of pigment in the peritoneum, but further study brought to light other differences. These few examples indicate that whenever we find two specimens differing in coloration it is possible that they represent different species and that other differences should be searched for.

Habits.—Our knowledge concerning the habits of these fishes must necessarily be limited. The dredging records indicate in most cases, nothing but the depth at which the species exist and the kind of bottom they inhabit. The structure of the body, from analogy, indicates in some cases what the habits may be. The species taken in intermediate hauls are of course free-swimming forms. The majority of the species of the genus have the body compressed and deepened and probably seldom rest upon the bottom. The rays of the lower pectoral lobe are elongate in a number of species and possibly are used as feelers. *C. pycnosoma* and the few other species with depressed bodies probably come to rest upon the bottom as do the species of *Liparis*. *C. rhodomelas*, judging from the contents of the stomach and the character of the teeth, feeds mainly upon Ophiurians and must remain in close proximity to the bottom. The genus is represented on all kinds of ooze and rock bottom.

Summary.—In order to present a guide to the study of the specific characters of these fishes the following outlines are given. The first list suggests the characters which have been found to be the most useful in distinguishing the species. The second list involves those characters which were studied but not used to any extent. With

further study some of these characters will doubtless be found to be of considerable value in designating species. For modification of characters see table on page 35.

LIST 1

Body	Shape.
	Depth.
	Length.
	Texture.
Head	Length.
	Depth.
	Width.
Snout	Depth
	Projecting.
Eye	Size.
	Pupil.
	Color.
Gill slit	Size.
Teeth	Arrangement.
	Trilobed.
	Size.
Dorsal	Notched.
	Buried.
Caudal	Forked.
Pectoral	Number of rays.
	Notch.
	Length lower lobe.
Disk	Size.
	Shape.
	Position.
Vent	Position.
Coloration	Body.
	Gill cavity.
	Mouth.
	Peritoneum.
	Stomach.
Distribution.	

LIST 2

Nostril	Length tube.
	Position.
Pores	Formula.
	Position.
	Rudimentary.
Dorsal	Number of rays.
	Segmentation of rays.
	Origin.
	Connection to caudal.
Anal	Number of rays.
	Connection to caudal.
Caudal	Number of rays.
Pectoral	Position.
Prickles.	
Pyloric coeca	Number
	Color.
	Length.

DISTRIBUTION

The genus *Careproctus* is widely distributed, as is usual with deep-water genera. It is represented in the moderately cold waters of the north and south temperate regions and at greater depths in the tropical Pacific. It has not been recorded from the tropical Atlantic or the Indian Ocean but may reasonably be expected to be discovered in these regions.

The giant species of the genus, as is true of *Liparis*, are most common in the North Pacific. The giant species and their distribution are as follows: *C. ovigerum*, 318 mm.; off British Columbia, depth 1,588 fathoms; *C. longipinnis*, 270 mm., Arctic Ocean, depth 702 fathoms, *C. trachysoma*, 263 mm., Japan Sea, depth 318 fathoms; *C. cypselurus*, 260 mm., coast of Washington to Okhotsk Sea, depth 510–887 fathoms; *C. colletti*, 248 mm., Gulf of Alaska to Okhotsk Sea, depth 284–629 fathoms; *C. rastrinus*, 280 mm., Okhotsk Sea, depth 73–119 fathoms. Two species, *C. cypselurus* and *C. colletti*, range from the American to the Asiatic coast, but the largest specimens

of both species have been taken from the western end of their areas of distribution. Bering Sea, the Okhotsk Sea, and the northern part of the Japan Sea appear to be more favorable to the production of large species and their existence nearer the surface of the ocean.

The highest temperature in which a species of *Careproctus* has been taken is a doubtful one of 59° F. for *C. ranula*. The average for this species is 42.2° F. None of the other species have been taken in temperatures above 45° F. The majority of the species are found in a temperature of 40° F. The regions inhabited by these fishes are little or not at all affected by the change of the seasons. The records that we have indicate that few, if any of the species, range through more than 10° of temperature.

Asiatic and American species.—The Japanese and American species are mainly distinct. At present only two species, *C. cypselurus* and *C. colletti*, are known to be common to both the American and Japanese faunas.

Regions.—Our records concerning the distribution of the species of this genus are too incomplete to offer a basis for generalizing. Many of the species are known from but a single locality. The data that we have indicates that the North Atlantic species are different from the North Pacific species. Only two species, *C. cypselurus* and *C. colletti*, are recorded from both sides of the Aleutian Islands; *C. gilberti* is a possible third species. None of the species are common to the two sides of the Japanese Archipelago. The Gulf of Alaska, Bering Sea, Okhotsk Sea, and the east and west coasts of Japan appear to have distinctive species. None of the species of the tropical Pacific have been taken in the North Pacific. We should expect to find that the Arctic Current has distributed the Bering Sea species southward to Japan. Our records do not indicate that this has happened to any great extent.

Careproctus, as well as *Liparis*, has but a meager representation in the North Atlantic. Only four species are recorded from this region and adjacent portions of the Arctic Ocean. Other species will doubtless be discovered during further explorations but apparently the genus is poorly represented in this region.

When we compare the range of specific distribution of the species of *Careproctus* with those of *Liparis* we find a similarity. We have seen that some tide-pool species of *Liparis* range through practically 20° of latitude. None of the species of *Careproctus* are known to range through more than 20° of latitude. The records that we have do not indicate that these deep-water species have a wider range of distribution than the shallow-water species.

Closely related species.—The close relatives of the majority of the species have yet to be discovered. In no case can the most closely related species be said to inhabit the same environment. The

nearest approach to this condition is that of *C. cypselurus*, Bering Sea, depth 510 to 887 fathoms, and *C. furcellus*, among the Aleutian Islands, depth 480 fathoms. A splendid example of closely related species inhabiting neighboring regions is that of *C. phasma*, Bering Sea, depth 46 to 59 fathoms; *C. spectrum*, Gulf of Alaska, depth 92 to 110 fathoms; and *C. melanurus*, British Columbia to California, depth 284 to 876 fathoms.

Bathymetrical distribution.—As has previously been said, species of *Careproctus* have been taken at depths between 30 and 1,823 fathoms. The species are found nearer the surface in the northern regions. Two-thirds of the species are found between 100 and 500 fathoms. Only four are found below 500 fathoms. The center of population for the genus is at about 300 fathoms. The red light rays fail to penetrate below this level.

Some of the species are known to have considerable vertical distribution. *C. cypselurus* has a vertical distribution of 377 fathoms, *C. reinhardi* 395 fathoms, *C. ranula* 354 fathoms, *C. mollis* 347 fathoms, *C. colletti* 341 fathoms, and *C. melanurus* 592 fathoms.

Center of dispersal.—The genus *Careproctus* apparently has had the same place of origin and dispersal as *Liparis*. The regions of distribution of the two genera are quite similar except that *Careproctus* typically inhabits a lower level than *Liparis*. The North Pacific appears to be the region from which representatives of these two genera migrated to the North Atlantic and southward in the Pacific. The most primitive species, the greatest number of species, the greatest amount of structural variation, and largest species are found in this region.

KEY TO SPECIES OF CAREPROCTUS [13]

A[1]. Dorsal with a shallow notch; teeth trilobed.
  B[1]. Body stout; pectoral notch shallow; dorsal 42; anal 37; pectoral 37, peritoneum pale ..... pycnosoma.
  B[2]. Body slender; pectoral notch deep; dorsal 48; anal 40; pectoral 34; peritoneum black ..... attenuatus.
A[2]. Dorsal unnotched.
  C[1]. Teeth short, stout, (cf. *ectenes*), strongly trilobed, (cf. *mollis*, *simus*, and *sinensis*, *melanurus*, and *opisthotremus*); peritoneum, except in attenuatus, pale.
    D[1]. Anterior dorsal rays with their tips projecting above the fin membrane.
      E[1]. Depth less than 6; head less than 4; snout not projecting; gill slit above the pectoral; dorsal 42; anal 37 ..... pycnosoma.
      E[2]. Depth more than 6; head more than 4; snout distinctly projecting; dorsal 49; anal 43;
        F[1]. Disk less than 3 in head ..... curilanus.
        F[2]. Disk more than 3 in head ..... ectenes.

[13] Species listed in the appendix not included.

D². Anterior dorsal rays weak, their tips not projecting above the fin membrane, usually buried in pseudotissue.
G¹. Lower lobe of the pectoral shorter than the head; color pale or dusky.
H¹. Gill slit in front of 3 or 4 pectoral rays; depth less than 6.
I¹. Pectoral 33; snout projecting; eye 3 in the head____**simus.**
I². Pectoral 35; snout not projecting; eye 4.8 in the head_____**mollis.**
H². Gill slit above the pectoral or in front of the upper ray.
J¹. Occiput high; depth 5 or less.
K¹. Snout projecting; skin on the head extremely lax; the pores on the chin and snout in pits; body much compressed.
L¹. Pectoral 30; disk 3.5_____**sinensis.**
L². Pectoral 24; disk 4.2_____**segaliensis.**
K². Snout not projecting; skin not lax; pores on head not in pits; body stout, little compressed.
M¹. North Pacific: anal 46; pectoral 37; disk 5_____**bowersianus.**
M². South Atlantic; anal?; pectoral?
N¹. Pectoral notched; rays 31; disk 2.2_**falklandica.**
N². Pectoral unnotched?_____**pallidus.**
J². Occiput not high; depth distinctly more than 5.
O¹. Disk 3.7; lower lobe of the pectoral 1.5, first dorsal ray elongate, equal to the orbit, longer than the 3 or 4 succeeding rays; stomach pale; peritoneum black. **attenuatus.**
O². Disk 2.7; lower lobe of the pectoral 2.4; first dorsal ray about equal to one-half the eye, shorter than the second ray; stomach black; peritoneum pale, dotted_____**homopterus.**
G². Lower lobe of the pectoral longer than the head; teeth very stout, the lateral lobes nearly equal to the central lobe; color black. **rhodomelas.**
C². Teeth more elongate, slender (cf. *mollis*, *melanurus*, *sinensis*), simple, sometimes arrow shaped, the lateral lobes hardly evident, (cf. *opisthotremus*, *gilberti*), frequently recurved; peritoneum pale or black.
P¹. Teeth rather short and stout, (see *ovigerum*), the cutting surfaces oblique; peritoneum pale to black.
Q¹. Gill slit above the pectoral.
R¹. Pectoral more than 25.
S¹. Disk as large or larger than the eye, not much cupped.
T¹. Body slender; depth more than 5. Atlantic.
U¹. Eye less than 4 in the head; pectoral notch hardly evident. **ranula.**
U². Eye more than 4 in the head.
V¹. Pectoral notch shallow; dorsal 47; anal 41__**micropus.**

V². Pectoral notch deep; dorsal 55; anal 45; pectoral 33. **reinhardi.**

T². Body deep; depth less than 5.

W¹. Atlantic.

X¹. North Atlantic; lower lobe of the pectoral longer than the head; disk 4.6--**longipinnis.**

X². South Atlantic; lower lobe of the pectoral shorter than the head; disk 2----**georgianus.**

W². North Pacific.

Lower lobe of the pectoral shorter than the head; disk 3.3---------**phasma.**

S². Disk smaller than the eye, rarely equal to it; usually distinctly cupped or triangular.

Y¹. Caudal not forked; pectoral distinctly notched.

Z¹. Peritoneum silvery, undotted; mouth and gill-cavity pale.

a¹. Lower lobe of the pectoral nearly equal to the head or longer than the head; no prickles.

b¹. Pacific, south of Alaska Peninsula----------**spectrum.**

b². Atlantic----------**longipinnis.**

a². Lower lobe of the pectoral about 2 in the head; Gulf of Tartary; cactuslike prickles present----------**acanthodes.**

Z². Peritoneum black, rarely silvery and dotted; mouth and gill cavity dusky to black; no prickles; British Columbia to California. **melanurus.**

Y². Caudal forked; the pectoral notch hardly evident or absent.

c¹. Depth 4.5; pectoral slightly notched; pyloric coeca 29--------**cypselurus.**

c². Depth 4; pectoral unnotched; coeca 45----------**furcellus.**

R². Pectoral with less than 25 rays; disk deeply cupped.

d¹. Upper pectoral ray not elongate; middle pectoral rays not rudimentary.

e¹. Color pale; tail short----------**abbreviatus.**

e². Color black; tail attenuate----------**bathycoetus.**

d². Upper pectoral ray greatly elongate; middle pectoral rays rudi-

mentary----------longifilis.

Q.[2] Gill slit extending down in front of the pectoral fin.

f[1]. Disk well developed, not over 4 in the head.

g[1]. Body deep; depth not over 4 in the length; vent near the disk----------ovigerum.

g[2]. Body depressed, elongate; depth about 6; vent far back from the disk----------opisthotremus.

f[2]. Disk small, 6 or more in the head.

h[1]. Gill slit in front of not more than 6 pectoral rays.

i[1]. Peritoneum silvery, undotted.

j[1]. Eye 3.4; dorsal, 55; anal, 49; pectoral, 33–35; no prickles. pellucidus.

j[2]. Eye 4.6; dorsal, 59; anal, 52; pectoral, 34–37; cactuslike prickles present----------rastrinus.

i[2]. Peritoneum silvery, dotted; dorsal 58; anal 53; pectoral 31–32; cactuslike prickles present----------trachysoma.

h[2]. Gill slit in front of 10 or more rays.

k[1]. Disk small, 7 to 9 in the head----------gilberti.

k[2]. Disk minute, more than 9 in the head----------ostentum.

P[2]. Teeth slender, lanceolate, recurved; the cutting surface appearing horizontal when the jaws are opened, outer teeth appearing little shorter than the inner teeth; peritoneum black except in *entargyreus*.

l[1]. Body deep; depth less than 5 in the length; lips pale; lower lobe of the pectoral about 2 in the head, not reaching beyond the vent-roseofuscus.

l[2]. Body not so deep; depth more than 5 in specimens less than 120 mm. in length; lower lobe of the pectoral distinctly less than 2 in the head, reaching past the vent.

m[1]. Prickles absent; lips dark or black; lower lobe of the pectoral about equal to the head, usually reaching midway between vent and anal fin----------colletti.

m[2]. Thumb-tack prickles present; lower lobe of the pectoral about 1.5 in the head, reaching little past the vent.

n[1]. Peritoneum black; pupil moderate; depth 144–428 fathoms----------entomelas.

n[2]. Peritoneum pale, dotted; pupil minute; depth 35–66 fathoms----------entargyreus.

CAREPROCTUS PYCNOSOMA Gilbert and Burke

Careproctus pycnosoma GILBERT and BURKE 1912*b*, p. 372.

Type.—No. 73340, U.S.N.M.; *Albatross* Station 4803, off Cape Rollin, Simushir Island, Japan; depth 229 fathoms. Length 46 mm.

Distribution.—Off Simushir Island, Japan, *Albatross* Station 4803; depth 229 fathoms. Type specimen examined.

Relationships.—In the character of the anterior dorsal rays and the firm body *C. pycnosoma* appears to be the least modified of any

of the species of the genus. The short, firm body, the number of fin rays, the dentition, the truncate snout, and the coloration of the peritoneum serve to distinguish *C. pycnosoma* from the other species having a notched dorsal.

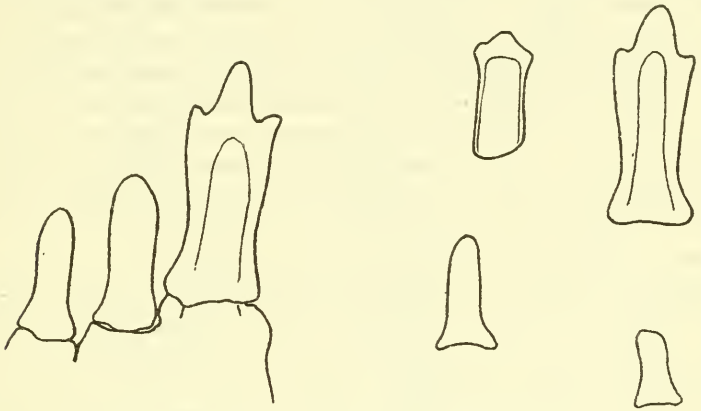

FIGURE 24.—CAREPROCTUS PYCNOSOMA. TEETH FROM TYPE

Synopsis.—Dorsal, 42; anal, 37; pectoral, 37; pyloric coeca, 14. Depth of body 5.5 in length without caudal. Disk well formed, flat, 3 in the head. Gill slit above the pectoral fin. Teeth short and stout, strongly trilobed. Snout not projecting. Dorsal fin with a shallow notch. Pectoral with a very shallow notch, the

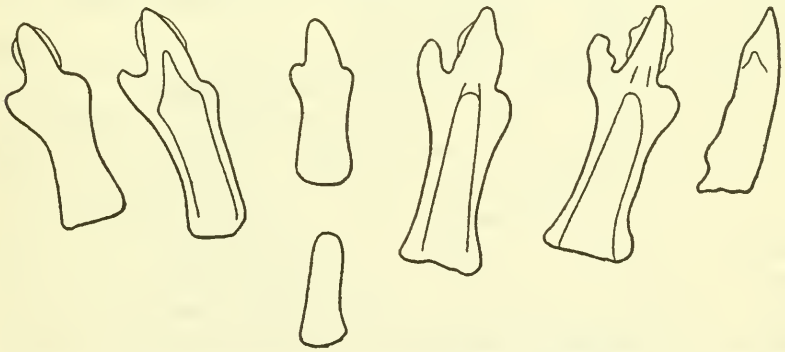

FIGURE 25.—CAREPROCTUS CURILANUS. TEETH FROM TYPE

notch hardly evident; the lower lobe 2.5 in the head. Color dusky gray; peritoneum pale. A small species, reaching a length of 46 mm.

CAREPROCTUS CURILANUS Gilbert and Burke

Careproctus curilanus GILBERT and BURKE 1912*b*, p. 373.

Type.—Male, No. 73341, U.S.N.M.; *Albatross* Station 4803, off Simushir Island, Kuril Group, Japan; depth 229 fathoms. Length 72 mm.

Distribution.—Off Simushir Island, Japan; *Albatross* Station 4803; depth 229 fathoms. Two specimens examined.

Relationships.—*C. curilanus* closely resembles *C. ectenes* in the depressed head, projecting snout, and distinct type of dentition. *C. curilanus* appears to differ from *C ectenes* in the shorter body. larger disk and larger gill slit. In addition, *C ectenes* appears to be distinct in having the dorsal notch more or less developed, the pyloric coeca absent, a smaller number of pectoral rays, and the vent farther from the disk. The two species appears to be separated geographically, but there is no evident barrier between. The differences we have enumerated may fall within the range of individual variation and the two species be found to be identical though at present the evidence we have indicates that they are distinct.

Synopsis.—Dorsal 49; anal 43; pectoral 33–34; pyloric coeca 6. Depth of body 6.7–6.8 in length without caudal. Disk 2.7–2.8 in head. Teeth strongly trilobed. Snout depressed and distinctly projecting. Gill slit extending down in front of from one to three pectoral rays. Dorsal fin unnotched; the anterior rays projecting, about equal in length. Vent close to the disk. Color grayish. Reaching a length of 74 mm.

CAREPROCTUS ECTENES Gilbert

Careproctus ectenes Gilbert, 1896 p. 442.
Careproctus (Allurus) ectenes Jordan and Evermann, 1898, p. 2136.

Type.—No. 48618, U.S.N.M.; Bering Sea, *Albatross* Station 3331; depth 350 fathoms. Length 70 mm.

Distribution.—Bering Sea, *Albatross* Stations 3331 and 3785; depth 270 to 350 fathoms. Five specimens examined.

Relationships.—*C. ectenes* closely resembles *C. curilanus.* A discussion of the similarities and differences between these two species is given in the discription of C. *curilanus.* In the presence of the dorsal notch and the trilobed dentition *C. ectenes* resembles the most primitive members of the genus. In the reduction of the pyloric coeca, the distinct dentition, the depressed head, and projecting snout the species has diverged widely from the primitive type. If the coeca were always absent the species would be sufficiently distinct to place in a separate genus.

Description of type.—Body slender, elongate, firm, depressed; depth 7.7 in length; width through base of pectoral greater than depth. Head slender, depressed, 4.6 in the length, wider than deep; occiput not swollen; profile low, gradual. Mouth small, with little lateral cleft under the projecting snout; maxillary nearly reaching vertical from middle of pupil. Teeth as in *C. curilanus,* stout, in broad bands, distinct in that the margin of the lobes are flangelike, arranged in oblique rows; the inward diverging rows prominent, eas-

ily counted. Snout depressed, bluntly rounded, overlapping mouth for half the pupil, resembling the snout of *C. simus*. Nostrils single, far apart, with a raised rim. Eye large 3.2 in head. Gill slit small, 5.2 in head, above the pectoral. Pores normal, not enlarged, two above gill slit, the posterior one minute. No prickles. Pyloric coeca absent.

Dorsal notched; the first ray elongate, about 3.2 in head; the tip projecting up above the skin, the two or three succeeding rays short-

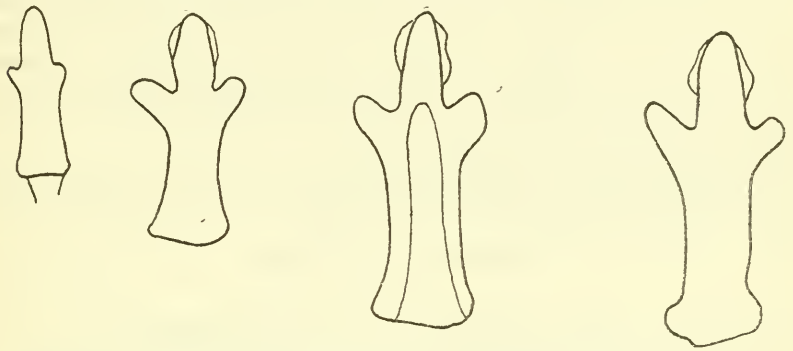

FIGURE 26.—CAREPROCTUS ECTENES. TEETH FROM TYPE

ened, the following rays increasing gradually in length. Anterior anal rays with free tips. Caudal slender, truncate, of about eight rays; dorsal and anal connections to the coudal apparently not greater than basal third of caudal. Pectoral notched; the lower lobe of seven rays graduated in length, reaching vent or beyond; upper edge of pectoral on a level with lower part of the eye. Disk small, equal to the eye or smaller, posterior edge under base of upper pectoral ray; the flap broad posteriorly. Vent distant from disk by three-fourths diameter of disk, behind a vertical from the gill slit.

Color nearly a uniform dusky brown, lighter on snout and belly; mouth, gill cavity, and stomach white, peritoneum white, dotted.

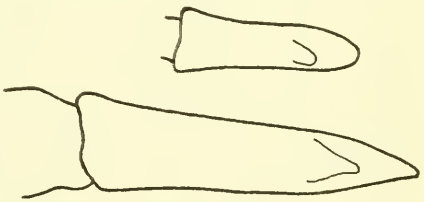

FIGURE 27.—CAREPROCTUS ECTENES. SIDE VIEW OF TEETH FROM SPECIMEN NO. 64043, U.S.N.M.

Synopsis.—Dorsal 48; anal 44 pectoral 30–32; pyloric coeca 0–6. Depth of body 7.1 to 8 in length without caudal. Disk 3.2–4.6 in the head. Teeth strongly trilobed. Snout depressed and distinctly projecting. Gill slit above the pectoral. Dorsal fin typically notched, sometimes the anterior rays equal in length. Vent distant from disk by three-fourths diameter of disk. Color dusky brown to grayish. Reaching a length of 87 mm.

Remarks.—The presence of pyloric coeca in all the specimens of this species is somewhat doubtful. In the specimens examined the

presence of coeca could be detected in only one specimen, in which six very short and small coeca were found adhering closely to the pylorus. In another specimen some filaments may have represented coeca.

In this species the dorsal fin is more or less distinctly notched and the anterior rays are not buried but project distinctly. The anterior dorsal ray is typically longer than the two or three succeeding rays. In one or two specimens the anterior ray is about equal to the succeeding rays and thus resembles the condition found in *C. curilanus*. In No. 64043, U.S.N.M., larger specimen, the first dorsal ray is contained 3.4 in the head, the third ray 5; in the smaller specimen the first dorsal ray is contained 2.6 in the head, the second ray 3.3, and the fourth ray 5.5, the following rays increasing in length.

The specimens No. 64043 are lighter than the type, being grayish and resembling the coloration of *C. curilanus*.

CAREPROCTUS SIMUS Gilbert

Careproctus simus GILBERT, 1896, p. 444.

Type.—No. 51688, U.S.N.M.; *Albatross* Station 3331, Bering Sea; north of Unalaska; depth 350 fathoms. Length 71+ mm. (Caudal absent.)

Distribution.—Bering Sea, north of Unalaska, *Albatross* Station 3331; depth 350 fathoms.

Relationships.—In most respects *C. simus* agrees with *C. mollis*, differing in the projecting snout and larger eye. In general appearance, especially in the broad head, *C. simus* resembles *C. spectrum* and related species. It resembles *C. curilanus* in the projecting snout, possibly in the condition of the anterior dorsal rays and in other characters. The dentition of these two species is quite distinct. *C. simus* is known from a single unsatisfactory specimen and we can not be certain of all the characteristics of the species.

FIGURE 28.—CAREPROCTUS SIMUS. TEETH FROM TYPE

Description.—Dorsal 47+; anal 41+; pectoral 33; pyloric coeca 20. Depth of body 1.3 in head; eye 3; disk 3.8; snout 3.1; internostril 2.9.

Body rather deep at union with head, tapering rapidly for a short distance, then more gradually until the tail becomes attenuate. Head heavy, broad, flattened on top, resembling *C. spectrum*; depth of head greater than width of head; profile descending gradually to tip of snout and then retracting to the mouth. Mouth broad, the angle

reaching past vertical from front of eye. Teeth short, strong, trilobed, the lateral lobes weakly developed, forming a shoulder; teeth are in eight oblique rows in the half of the lower jaw, nine in the upper jaw; the rows widely spaced; outer teeth smaller. Snout heavy, broadly rounded, projecting beyond upper lip for diameter of pupil. Nostril in a low tube, barely raised above the skin, the posterior margin raised into a rounded flap. Eye large, prominent, black, pupil oval, horizontal. Gill slit small, 4 in the head, extending down in front of three pectoral rays. Two suprabranchial pores; other pores normal. No prickles. Pyloric coeca 20, about equal to the eye.

Anterior dorsal rays apparently stiff, not filamentous and undulating beneath the skin; first ray elongate, as long as the second ray; the anterior rays little shortened; not buried in pseudotissue. Caudal absent. Pectoral notched; the lower lobe of six partly free, thickened, and exserted rays, reaching a little past vent, 2.2 in head. Disk well developed; distance from tip of lower jaw to disk 3 in head. Vent close to disk, in front of gill opening.

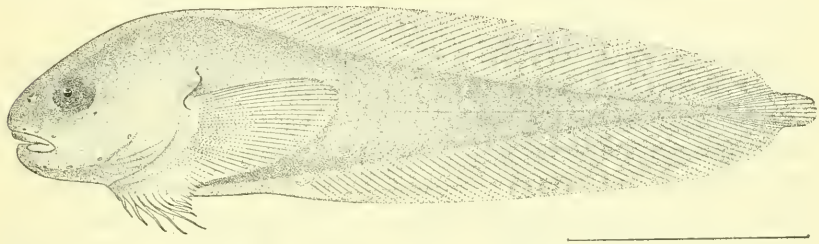

FIGURE 29.—CAREPROCTUS MOLLIS. TYPE. A TYPICAL SPECIES OF THE GENUS IN SHAPE AND GENERAL APPEARANCE

Coloration: Discolored, apparently dusky with the mouth and gill cavity pale; the peritoneum discolored, possibly pale.

Synopsis.—Dorsal 47 + ; anal 41 + ; pectoral 33; pyloric coeca 20; disk not cupped, 3.8 in the head. Gill slit extending down in front of three pectoral rays. Teeth stout, the lateral lobes weakly developed, forming a shoulder. Snout distinctly projecting. Anterior dorsal rays rather stiff, little shortened.

CAREPROCTUS MOLLIS Gilbert and Burke

Careproctus mollis GILBERT and BURKE 1912*a*, p. 77.

Type.—No. 74383, U.S.N.M.; *Albatross* Station 4784, south of Attu Island, Bering Sea; depth 135 fathoms. Length 85 mm.

Distribution.—*Albatross* Stations 4781 and 4784, Bering Sea; depth 135–482 fathoms. Five specimens examined.

Relationship.—*C. mollis* appears to be related to *C. bowersianus*. It differs from the latter species in the smaller eye, humped body, and larger disk. For a comparison with *C. simus* see description of the latter species.

Synopsis.—Dorsal 51; anal 47; pectoral 35; pyloric coeca 8. Disk flat, 3.5 in the head. Gill slit extending down in front of three pectoral rays. Teeth stout, distinctly trilobed. Anterior mandibular pores united. Snout not projecting. Eye 4.8 in the head. Occiput swollen and the body humped at the nape. Color pale. Our specimens reaching a length of 85 mm.

FIGURE 30—CAREPROCTUS MOLLIS. TEETH FROM TYPE

CAREPROCTUS SINENSIS Gilbert and Burke

Careproctus sinensis GILBERT and BURKE 1912*b*, p. 371.

Type.—No. 73339, U.S.N.M.; *Albatross* Station 4813, off Sado Island, Japan Sea; depth 200 fathoms. Length 72 mm.

Distribution.—Japan Sea, off Sado Island, *Albatross* Station 4813; depth 200 fathoms. See remarks. Three specimens examined.

Relationships.—*C. sinensis* resembles *C. segaliensis* in many respects. It can be distinguished from the latter species by the larger number of pectoral rays, larger disk, and minor differences.

Synopsis.—Dorsal 47?; anal 47; pectoral 33; pyloric coeca 21. Depth of body 4 in length without caudal; depth of head 4.3; width of head 7; head and body greatly compressed, resembling *Crystallichthys mirabilis*. Snout projecting as in the latter species. Gill slit above the pectoral fin. Teeth stout, weakly trilobed, the lateral lobes forming a shoulder. One suprabranchial pore; mandibular pores enlarged, the anterior pair united. Anterior dorsal rays shortened, increasing rapidly in length. Disk normal, flat, 3.5 in head. Lower lobe of pectoral short, 2.3 in the head, reaching slightly past vent. Vent close to disk. Color pale. Our largest specimen 72 mm. in length.

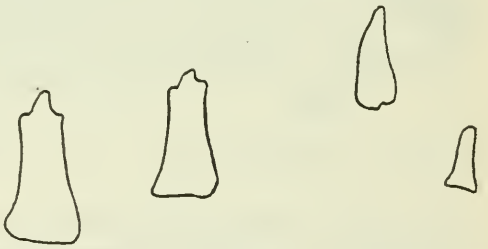

FIGURE 31.—CAREPROCTUS SINENSIS. TEETH FROM SPECIMEN NO. 53812, U.S.N.M.

Remarks.—Specimens No. 53811 and No. 53812, from *Albatross* Stations 2847 and 2851, south of the Alaska Peninsula, differ from the type in several respects. These specimens are in poor condition and probably represent a new species. Body outline not abruptly descending above pectoral, the dorsal outline gradual. Occiput not swollen. Eye small, the lower half silvery. Pyloric coeca 25. Anterior dorsal rays increasing gradually in length. Lower lobe of pectoral not reaching vent. Vent back of disk by diameter of disk. Two suprabranchial pores present, small.

CAREPROCTUS SEGALIENSIS Gilbert and Burke

Careproctus segaliensis Gilbert and Burke, 1912*b*, p. 367.

Type.—No. 73336, U.S.N.M.; *Albatross* Station 5026, off Cape Patience, Saghalin, Okhotsk Sea; depth 119 fathoms. Length 75 mm.

Distribution.—Okhotsk Sea, off Saghalin, *Albatross* Station 5026; depth 119 fathoms.

Relationships.—*C. segaliensis* bears a close resemblance to *Crystallicthys mirabilis* in the compressed head and projecting snout; in other respects it is quite distinct. See *Careproctus sinensis* for comparisons with the latter species.

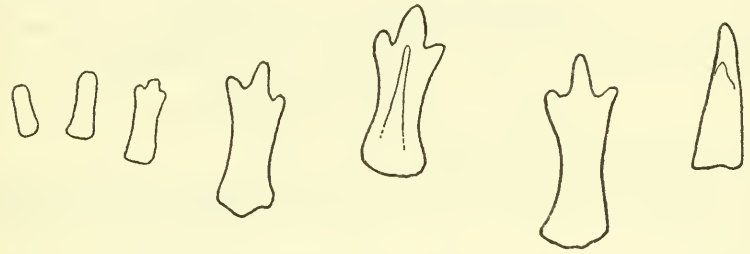

Figure 32.—Careproctus segaliensis. Teeth from type

Synopsis.—Dorsal 58; anal 52; pectoral 24; pyloric coeca 17. Depth 4.5 in length without caudal; depth of head 5.6; width of head 8; head and body greatly compressed, gelatinous. Snout projecting as in *Crystallichthys mirabilis.* Gill slit above the pectoral fin. Teeth stout, distinctly trilobed. One suprabranchial pore; pores on head in pits; anterior mandibular pores united. Anterior dorsal rays buried in pseudotissue. Lower lobe of pectoral 2 in head. Disk small, cupped, 4.2 in head. Vent close to disk. Color pale, transparent. The type specimen the only one known, 75 mm. in length.

CAREPROCTUS BOWERSIANUS Gilbert and Burke

Careproctus bowersianus Gilbert and Burke, 1912*a*, p. 76.

Type.—No. 74382, U.S.N.M.; *Albatross* Station 4772, Bowers Bank, Bering Sea; depth 344 fathoms. Length 100 mm.

Distribution.—Bowers Bank, Bering Sea. *Albatross* Stations 4771 and 4772; depth 344 to 426 fathoms. Two specimens examined.

Relationships.—*C. bowersianus* does not closely resemble any known species. It is distinguished by a large, prominent eye and deep, stout body.

Synopsis.—Dorsal 52–53; anal 46–48; pectoral 36–37; depth 4.7–5 in length without caudal; depth of head 4.5–5; width of head 5.5–6.3; eye 3.7–4 in head. Snout not projecting. Gill slit above the pectoral fin or extending down in front of the upper ray. Teeth stout, strongly

trilobed. Two suprabranchial pores; rudimentary pores on the sides of the body. Anterior dorsal rays buried in tissue. Disk normal, 5 in

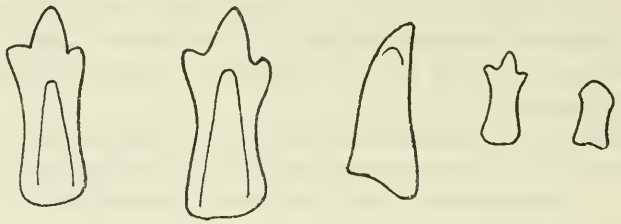

FIGURE 33.—CAREPROCTUS BOWERSIANUS. TEETH FROM COTYPE

the head; disk to vent 5.4–7 in the head. Color pale; stomach blackish. Only two specimens known, the largest 113 mm. in length.

CAREPROCTUS FALKLANDICA (Lonnberg)

Liparis antarctica falklandica LÖNNBERG, 1905, p. 17.
Careproctus falklandica BURKE, 1912*b*.

Distribution.—Antarctic Ocean, Berkeley Sound, Falkland Islands and Burchwood Bank; depth 16 to 150 meters. No specimens examined.

Relationships.—The single nostril and the coloration indicate that the species belongs with *Careproctus*.

Synopsis.—Pectoral 30 or 31. Depth of body about 3.7 in total length. Disk about 2.2 in head. Gill slit probably above pectoral. Teeth strongly trilobed. Dorsal unnotched. Color pale.

CAREPROCTUS PALLIDUS (Vaillant)

Enantioliparis pallidus VAILLANT, 1888, p. 22, pl. 4, fig. 3.
Liparis pallidus GARMAN, 1892, p. 70.
Careproctus pallidus BURKE, 1912*b*.

Distribution.—Orange Bay, Tierra del Fuego; depth 28 meters. No specimen examined.

Relationships.—I have formerly (1912*b*) given reasons for placing this species with *Careproctus*.

CAREPROCTUS ATTENUATES Gilbert and Burke

Careproctus attenuatus GILBERT and BURKE. 1912*a*, p. 79.

Type.—No. 74386, U.S.N.M.; Bering Sea, *Albatross* Station 4781; depth 482 fathoms.

Distribution.—Bering Sea; *Albatross* Station 4781; depth 482 fathoms. One specimen.

Relationships.—In many respects *C. attenuatus* resembles *C. homopterus*. A discussion of the differences between the two species is given under *C. homopterus*. The dorsal fin in *C. attenuatus* appears to be slightly notched and in this respect resembles the dorsal fin in *C. ectenes*.

Synopsis.—Dorsal 48; anal 40; pectoral 34; pyloric coeca about 10. Eye 3.1 in the head; disk 3.7, not cupped. Gill slit apparently

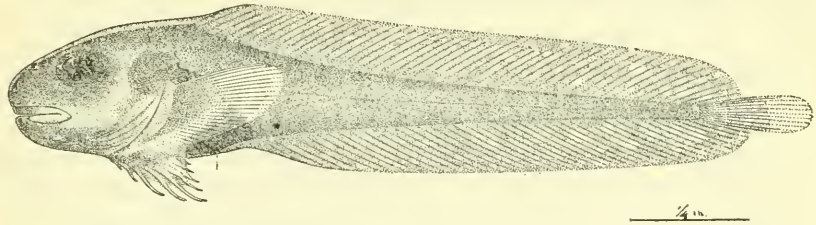

FIGURE 34.—CAREPROCTUS ATTENUATUS. TYPE, SHOWING GREATLY ATTENUATED BODY, APPROACHING THE CONDITION FOUND IN RHINOLIPARIS

above the pectoral fin. Teeth stout, strongly trilobed. Snout deep, not projecting. Head depressed, nearly as wide as deep. Body slender, depth 5.9 in length without caudal. Dorsal fin apparently notched as in *C. ectenes*; anterior dorsal ray elongate, longer than the two or three succeeding rays. Lower lobe of the pectoral 1.5 in the head. Vent midway between disk and anal. Color pale; peritoneum black. Only type specimen known.

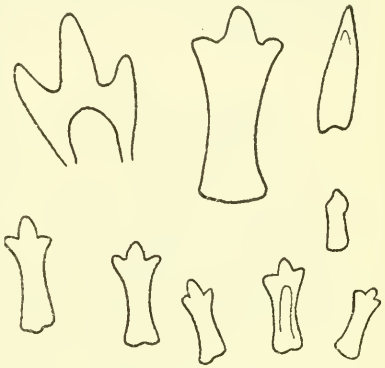

FIGURE 35.—CAREPROCTUS ATTENUATUS. TEETH FROM TYPE

CAREPROCTUS HOMOPTERUS Gilbert and Burke

Careproctus homopterus GILBERT and BURKE, 1912*b*, p. 374.

Type.—No. 73342, U.S.N.M.; *Albatross* Station 5029, southern part of the Okhotsk Sea; depth 440 fathoms. Length 49 mm.

Distribution.—Southern part of the Okhotsk Sea, *Albatross* Station 5029; depth 440 fathoms. One specimen.

Relationships.—*Careproctus homopterus* resembles *C. attenuatus* in many respects. It is distinguished from the latter species by the shape of the snout, the smaller eye, larger disk, the shorter first dorsal ray, and in other characters.

Synopsis.—Dorsal 55; anal 49; pectoral 32. Eye 3.7 in the head; disk 2.7, with a broad margin. Gill slit extending up from the base of the upper pectoral ray. Teeth stout, strongly trilobed. Snout not so deep as in *C. attenuatus*, rising gradually from the mouth. Body moderately deep and compressed, depth 6 in length. Dorsal fin unnotched; the anterior ray short, one-half the eye. Lower lobe of the pectoral 2.4 in the head. Vent separated from disk by less than

diameter of disk. Color pale to dusky; dusky toward the caudal, peritoneum pale; stomach appearing black through the abdominal wall. Only the type specimen known.

CAREPROCTUS RHODOMELAS Gilbert and Burke

Careproctus rhodomelas Gilbert and Burke, 1912*b*, p. 365.

Type.—Male, No. 73334, U.S.N.M.; *Albatross* Station 4958, off the Bungo Channel, Japan; depth 405 fathoms. Length 123 mm.

Distribution.—Southeast coast of Japan; *Albatross* Stations 4958 and 4980; depth 405–507 fathoms. Two specimens examined.

Relationships.—*C. rhodomelas* is not closely related to any known species. The heavy crushing teeth and the long lower pectoral lobe distinguish this species from all others with which it may be confused.

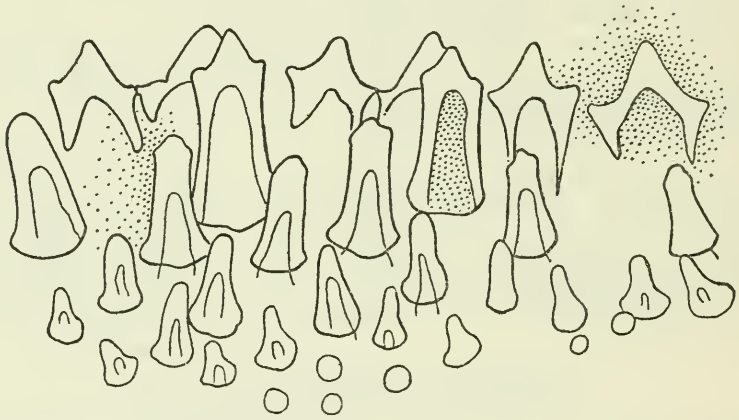

Figure 36.—Careproctus homopterus. Teeth from type

Synopsis.—Dorsal 56; anal 48; pectoral 31; caudal 9; pyloric coeca 12. Body slender; depth 5.5 in length without caudal; head 5.4. Teeth coarsely trilobed, the lateral lobes nearly as large as the central lobe. Gill slit extending down in front of three pectoral rays. Anterior dorsal rays increasing gradually in length. Lower lobe of the pectoral elongate, reaching past the origin of the anal fin, four-thirds times the head. Disk small, triangular; 8.3 in the head. Color blackish; peritoneum and stomach black. Only two specimens known.

CAREPROCTUS RANULA (Goode and Bean)

Liparis ranula Goode and Bean, 1879, p. 46.

Careproctus ranula Goode and Bean, 1895, p. 275, fig. 251.—Jordan and Evermann, 1898, p. 2134.

Careproctus reinhardi Garman, 1892, p. 78, (part, not of Kröyer).—Jordan and Evermann, 1898, p. 2133, (part, after Garman).

Type.—Female, No. 22310, U.S.N.M.; *Speedwell* Station 117, off Halifax Harbor; depth 52 fathoms. Length 56 mm.

Distribution.—New England coast to Newfoundland; depth possibly 11–365 fathoms. Fifteen specimens examined.

Relationships.—*C. ranula* belongs with the spectrum group of species in which the head is blunt and heavy, the interorbital region broad, the peritoneum silvery and the teeth rather strong but simple or the lobes faintly indicated.

The three species of the North Atlantic, *C. ranula* (Goode and Bean), *C. reinhardi* (Kröyer), and *C. micropus* (Günther) closely resemble each other. The validity of all of these species has been questioned. By a number of writers, *C. reinhardi* has been regarded as identical with *C. gelatinosus* (Pallas). Garman (1892) refers *C. ranula* to the synonomy of *C. reinhardi*. Lutken (1898) indicates his uncertainty concerning the individuality of *C. reinhardi* and *C. micropus*. I have examined but one of these species, *C. ranula*, and can add but little toward the solution of the puzzle. I believe, however, that the three species should be recognized until we can eliminate them with certainity. From an examination of the descriptions and figures *C. ranula* appears to differ from *C. reinhardi* in the larger eye and shallower pectoral notch. *C. micropus* appears to differ from *C. reinhardi* in the shallower pectoral notch and possibly in the smaller number of fin rays. *C. ranula* and *C. micropus* agree in having a

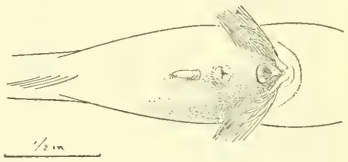

FIGURE 37.—CAREPROCTUS RHODOMELAS. VENTRAL VIEW SHOWING GREAT REDUCTION OF VENTRAL DISK

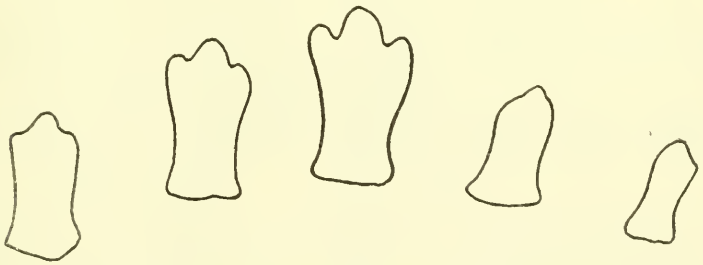

FIGURE 38.—CAREPROCTUS RHODOMELAS. TEETH FROM TYPE

shallow pectoral notch but appear to differ in the size of the eye and the number of fin rays.

Description.—The type is in such a poor state of preservation that it will not admit of description. The following note is extracted from the original description.

D. 48; A. about 48; P. 15 + 12 (13). Length without caudal 52 mm. Depth 0.25; head 0.25; orbit 0.7; disk 10. Teeth villiform. Gill slit extends upon the upper part of the root of the pectoral. Pectoral with 15 long rays and 12 or 13 short ones. Color uniform white.

Description of No. 28812, U.S.N.M.; dorsal 53; anal 49; pectoral 28; pyloric coeca about 9. Head about 5.3 in length without caudal. Eye 3.4 in head; disk 3.2.

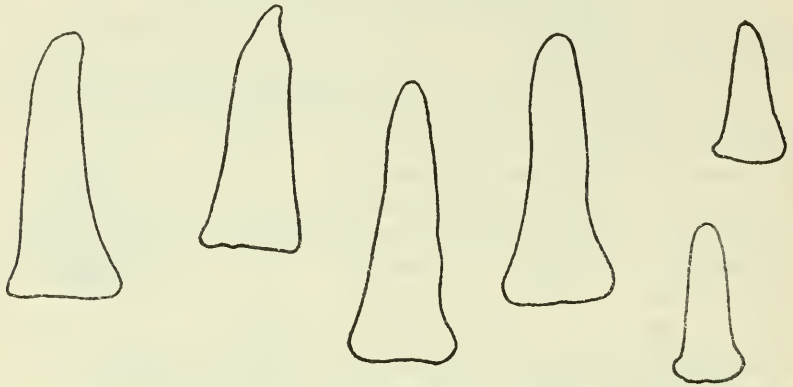

FIGURE 39.—CAREPROCTUS RANULA. TEETH FROM SPECIMEN NO. 9556, STANFORD UNIVERSITY ZOOLOGICAL MUSEUM, SHOWING VARIATION FROM TYPE

Body distended with eggs, rather elongate and slender. Head low, broad, nearly as wide as deep; interorbital flat; occiput low; sides of head nearly vertical. Mouth broad; maxillary reaching posterior

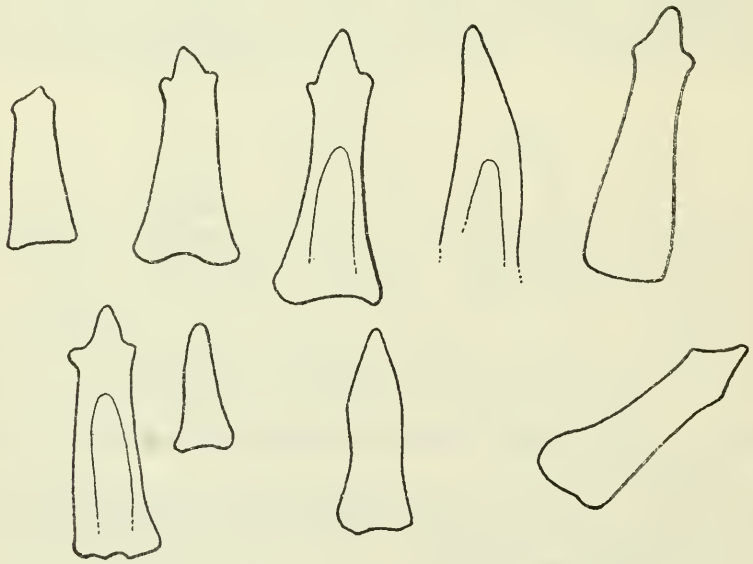

FIGURE 40.—CAREPROCTUS RANULA. TEETH FROM TYPE

margin of pupil. Teeth simple or the lateral lobes weakly developed, rather slender and elongate, slightly recurved; the oblique rows difficult to count; about 10 or 12 in the half of each jaw; inner teeth

larger but not especially prominent. Snout low, broad. Nostril in a tube in front of eye. Eye moderate; pupil large, round. Gill slit above the pectoral. No prickles. Pyloric coeca 9 or more, 2.7 in the head.

Anterior dorsal rays free beneath fin membrane, increasing gradually in length. Caudal of 8 or 10 slender rays, connected with its basal half to the anal. Pectoral with a shallow notch; the lower lobe hardly differentiated, of six rays, reaching slightly past the disk, 1.5 in the head; upper edge of pectoral on a level between eye and angle of mouth. Disk moderate, flat. Vent close to the disk.

Color pale; coeca, stomach, and peritoneum pale.

Synopsis.—Dorsal 53; anal 49; pectoral 28; pyloric coeca about 9. Depth of body less than length of head. Eye 3.4 in head; disk 3.2. Teeth simple, rather slender and elongate, sometimes a light shoulder near the tip or the lateral lobes distinct. Gill slit above the pectoral. Pectoral with a shallow notch, the lower lobe hardly differentiated, reaching slightly past the disk, 1.5 in the head. Color pale, including peritoneum and stomach.

CAREPROCTUS REINHARDI (Kröyer)

Liparis gelatinosus Reinhardt, 1842, p. 82, pl. 10.
Liparis reinhardi Kröyer, 1862, p. 252.—Collett, 1905, pl. 2, fig. 8. (part, confused with *C. longipinnis*).
Careproctus reinhardi Kröyer, 1862, p. 257.—Collett, 1880, p. 57, pl. 2, figs. 15–16.—Garman, 1892, p. 78, (part, confused with *C. ranula*).—Jordan and Evermann, 1898, p. 2133, (part, after Garman).
Liparis gelatinosus Günther, 1887, p. 67, (part, not of Pallas).

Distribution.—The types are from Greenland, Arctic Ocean; recorded from about Jan Mayen and Bear Island and off Arendal and in the Kara Sea; depth 263–658 fathoms.

Relationships.—*C. reinhardi* appears to be closely related to *C. ranula* and *C. micropus*. For a comparison of these species see description of *C. ranula*.

Synopsis.—Dorsal 54–55; anal 45–46; pectoral 32–33; depth of body less than length of head. Eye 5–6 in the head. Disk little larger than the eye. Teeth simple. Pectoral notched; the lower lobe shorter than the head. Color reddish or whitish.

CAREPROCTUS MICROPUS (Günther)

Liparis micropus Günther, 1887, p. 66, pl. 12, fig. B.—Lutken, 1898, p. 14.
Careproctus micropus Garman, 1892, p. 72.—Goode and Bean, 1895, p. 277.

Distribution.—Günther's specimens come from the Faroe Channel, depth 540 to 608 fathoms. Lutken records specimens from west of Greenland and Iceland, north of Iceland, and south of the Faroe Islands. No specimens examined.

Relationships.—*C. micropus* appears to be closely related to *C. ranula* and *C. reinhardi*. (See description of *C. ranula*.)

Synopsis.—Dorsal 47; anal 41. Depth of body less than length of head. Eye 5 in head; disk 4. Teeth simple. Gill slit apparently above base of pectoral. Lower lobe of pectoral shorter than head.

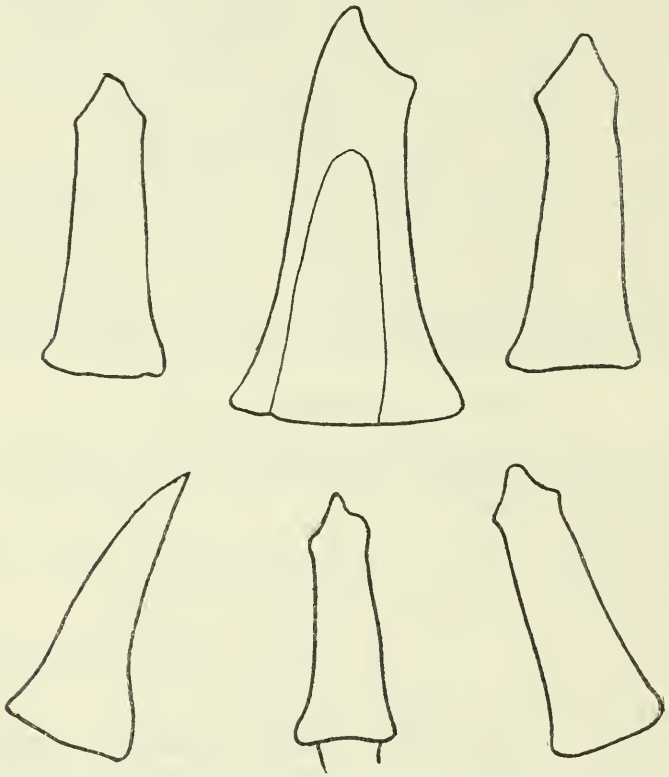

FIGURE 41.—CAREPROCTUS REINHARDI. TEETH FROM SPECIMEN NO. 28812, U.S.N.M.

CAREPROCTUS GEORGIANUS Lönnberg

Careproctus georgianus LÖNNBERG, 1895, p. 41, pl. 3.—BURKE, 1912*b*.

Distribution.—Antarctic Ocean, South Georgias, depth 195 m. No specimens examined.

Relationships.—In many respects *C. georgianus* resembles *C. phasma* and related species of the North Pacific.

Synopsis.—Dorsal 45–52; anal 42–46. Pectoral about 30. Depth a little more than 4 in total length. Disk 1.9–2.1 in head. Gill slit above base of pectoral. Teeth simple.

CAREPROCTUS PHASMA Gilbert

Careproctus phasma Gilbert, 1896, p. 443.—Jordan and Evermann, 1898, p. 2132.

Type.—No. 48604, U.S.N.M.; Bering Sea, *Albatross* Station 3254; depth 46 fathoms. Length 89 mm.

Distribution.—Southeastern Bering Sea, *Albatross* Stations 3254, 3256, 3530; depth 46 to 59 fathoms; temperature 34.9° to 36.2° F. Three specimens examined.

Relationships.—*C. phasma* closely resembles *C. spectrum* in the broad head and in general appearance. It can be distinguished from the latter species by the larger disk; the skin appears to be thicker and more opaque. *C. phasma* may be confined to shallower water than *C. spectrum*.

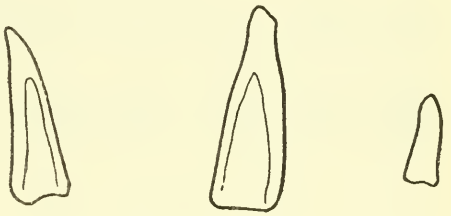

Figure 42.—Careproctus phasma. Teeth from type

Synopsis.—Dorsal 53; anal 45; pectoral 34; caudal 8; pyloric coeca 21. Eye 4 in head. Body heavy, deep, debth 3.7 in length without caudal. Head heavy, 3.7 in length; interorbital broad and flat; cheeks vertical. Teeth simple, slender. Snout blunt. Gill-slit above pectoral fin. Anterior dorsal rays buried in pseudol tissue. Lower lobe of pectoral 1.5 in head. Disk well developed, larger than eye, 3.3 in the head. Color pale or white; peritoneum silvery. This species is represented by three specimens, all of which are less than 100 mm. in length.

Figure 43.—Careproctus phasma. Teeth from specimen No. 53813, U.S.N.M.

CAREPROCTUS SPECTRUM Bean

Careproctus spectrum Bean, 1890, p. 40 (part).—Jordan and Evermann, 1898, p. 2133 (part).—Evermann and Goldsborough, 1907, p. 333 (part).

Type.—No. 45363, U.S.N.M.; *Albatross* Station 2848, north of the Shumagin Islands, Alaska; depth 110 fathoms; temperature 41° F. Length 97 mm.

Distribution.—Gulf of Alaska, *Albatross* Stations 2848 and 4295; depth 92–110 fathoms. Four specimens examined.

Relationships.—*C. spectrum* is closely related to *C. melanurus*. It differs from the latter species in having less pigment in the mouth,

gill cavity, peritoneum, and the posterior part of the body; the distribution is more northern, and the depth inhabited possibly a little greater.

Description of type.—Dorsal 52; anal 47; pectoral 32; caudal 10; pyloric coeca 21. Depth 4.3 in length without caudal; head 4. Eye 3.3 in head; disk 4.

Body heavy anteriorly, deep, short, tapering rapidly to the caudal. Head heavy; interorbital region broad and flat, cheeks nearly vertical, mouth broad; maxillary reaching vertical from middle of pupil. Teeth simple or one or both lateral lobes faintly developed, moderately stout to slender, hardly recurved; inwardly diverging rows very oblique and difficult to count, 10 or 12 in the half of each jaw; outwardly diverging rows more distinct, close set. Snout short, about 4 in head, broad, not projecting beyond mouth. Nostril in a short tube. Eye large, prominent; pupil oval, horizontal. Gill slit small about 3.3 in head, extending up from the base of the upper pectoral

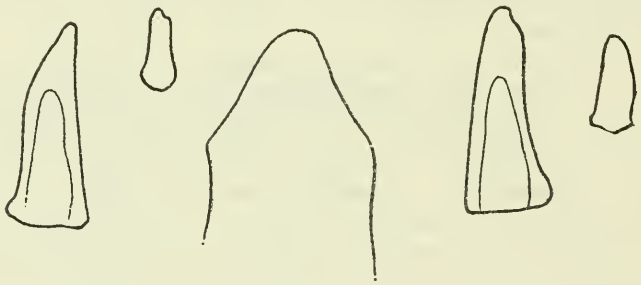

FIGURE 44.—CAREPROCTUS SPECTRUM. TEETH FROM TYPE

ray. Two suprabranchial pores present. Prickles absent. Pyloric coeca 21, 2.4 in head, on the left side.

Dorsal rays increasing gradually in length, the anterior rays rather stiff, their connection with the skin uncertain. Caudal of 10 slender rays, mutilated, connected for half its length to the anal. Pectoral notched; the upper lobe of 25 rays, reaching anal; lower lobe of eight slender, graduated rays, coiled at the tips, free nearly to the base, reaching anal, nearly as long as the head. Disk moderate, the margin rather thick, folded over posteriorly, the disk somewhat triangular, a little broader than long; distance from tip of lower jaw to disk 9.9 in length without caudal; front of disk just behind vertical from pupil. Vent next to disk.

Coloration: Skin transparent, lax; muscles flesh colored; mouth, gill cavity, and internal organs pale; peritoneum silvery, without dots; abdomen silvery.

Synopsis.—Dorsal 52; anal 47; pectoral 32; pyloric coeca 21. Depth 4.3 in length without caudal; head 4. Eye 3.3 in head; disk

4; smaller than eye. Body heavy, deep, short. Head heavy; interorbital region broad and flat. Teeth simple or with a slight shoulder. Snout blunt, not projecting. Gill slit extending up from base of the upper pectoral ray. Anterior dorsal rays increasing gradually in length. Lower lobe of the pectoral reaching the origin of the anal fin, about equal to the head. Disk somewhat triangular. Vent close to the disk. Color pale, little or no dark pigment anywhere. Four specimens known, reaching a length of about 100 mm.

CAREPROCTUS MELANURUS Gilbert

Careproctus melanurus GILBERT, 1890, p. 56.—JORDAN and EVERMANN, 1898, p. 2135.

Type.—Male, No. 44285, U.S.N.M.; *Albatross* Station 2925, off southern California; depth 339 fathoms. Length 179+ mm. (Caudal absent.)

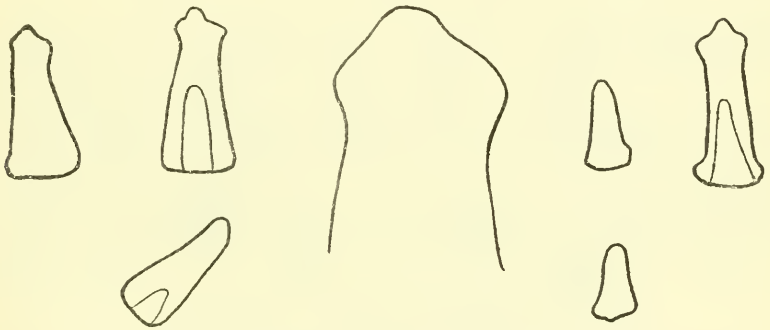

FIGURE 45.—CAREPROCTUS MELANURUS. TEETH FROM TYPE

Distribution.—British Columbia to southern California, *Albatross* Stations 2860, 2892, 2925, 3112, and 3186; depth 284 to 876 fathoms; temperature 36.5° to 44.1° F. Eleven specimens examined.

Relationships.—See description of *C. spectrum.*

Synopsis.—Dorsal 54; anal 47; pectoral 31; pyloric coeca 20–27. Depth 4.2–4.5 in length without caudal; head 4.3–4.5. Eye 3.5–4 in head; disk 6.4–6.9. Body rather deep and compressed. Head heavy; interorbital broad and flat. Teeth rather stout, simple or with the lateral lobes faintly developed. Snout blunt, not projecting. Gill slit above the pectoral fin. Disk small, less than the eye, cupped. Lower lobe of the pectoral 1.3 in the head, reaching more than half way to the orgin of the anal fin. Color pinkish or whitish; pertioneum mouth, gill cavity, caudal, and neighboring portions of dorsal and anal and the posterior surface of the pectoral black or dusky; posterior part of the body more or less dusky; peritoneum rarely whitish with scattered black dots. Eleven specimens, reaching a length of about 200 mm.

Remarks.—Note on specimen No. 604, U. S. B. F. Head not so flat as in the type; occiput rather deep. Caudal connected for fully half its length to the dorsal. Pectoral low, the upper edge a little above the angle of the mouth; the lower lobe of graduated, elongate rays, reaching more than half way to anal, 1.3 in the head; the three anterior rays free to the base, the remainder half free. Gill slit above the pectoral. Disk less than eye. Color whitish; posterior part of body, caudal, and neighboring parts of dorsal and anal dusky; mouth, gill cavity and peritoneum dusky; stomach white; inner surface of pectoral dusky. In some specimens the peritoneum is light and dotted.

CAREPROCTUS FURCELLUS Gilbert and Burke

Careproctus furcellus GILBERT and BURKE, 1912*a*, p. 80.

Type.—No. 74387, U.S.N.M.; *Albatross* Station 4781, Bering Sea; depth 482 fathoms. Length 129 mm.

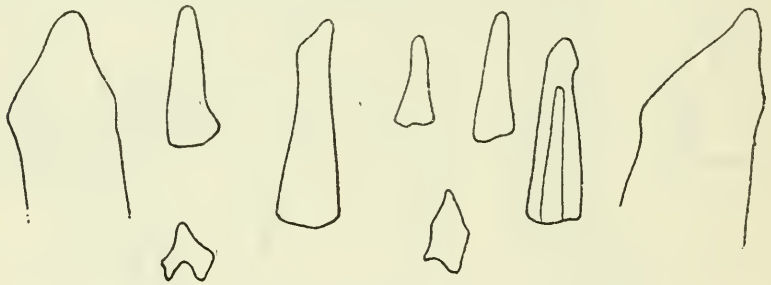

FIGURE 46.—CAREPROCTUS FURCELLUS. TEETH FROM COTYPE

Distribution.—Bering Sea, *Albatross* Station 4781; depth 482 fathoms. Two specimens examined.

Relationships.—See description of *C. cypselurus*. *C. furcellus* closely resembled *C. melanurus*, differing in the larger disk, the shorter, lower pectoral lobe, and in other characters.

Synopsis.—Dorsal 62; anal 57; pectoral 36; pyloric coeca 46. Depth 4 in length without caudal; head 3.7. Eye 3.7 in head; disk 4. Body shorter than in *C. cypselurus*, the posterior part not so attenuate. Head broad, interorbital wide, flat. Teeth rather elongate and slender, the lateral lobes forming a shoulder or absent. Gill slit above the pectoral fin. Caudal slightly forked. Pectoral fin unnotched. Disk well developed, smaller than the eye. Color reddish or pale, posteriorly the body and fins black; gill cavity, abdomen and the pectoral dusky; peritoneum black. Only two specimens known, reaching a length of 128 mm. or more.

CAREPROCTUS CYPSELURUS (Jordan and Gilbert)

Prognurus cypselurus JORDAN and GILBERT, 1898, in Jordan and Evermann, 1898, p. 2866; 1899, p. 478, pl. 77.—EVERMANN and GOLDSBOROUGH, 1907, p. 333, pl. 20.

Careproctus cypselurus GILBERT and BURKE 1912*b*, p. 362.

Type.—Male, No. 48232, U.S.N.M.; *Albatross* Station 3634, north of Unalaska, Bering Sea; depth 664 fathoms. Length 211 mm.

FIGURE 47.—CAREPROCTUS CYPSELURUS, SHOWING FORKED CAUDAL

Distribution.—North Pacific off the coast of Washington, Bering Sea, and the Okhotsk Sea; *Albatross* Stations 3074, 3634, 4797, 5015; depth 510–887 fathoms. Four specimens examined.

Relationships.—*C. cypselurus* bears a close resemblance to *C. melanurus*. The forked caudal of *C. cypselurus* serves to distinguish the two species. *C. cypselurus* bears a closer resemblance to *C. furcellus*. It can be distinguished from the latter species by the more elongate body; the eye and disk appear to be smaller, the gill slit larger, the number of coeca less, and the pectoral slightly notched.

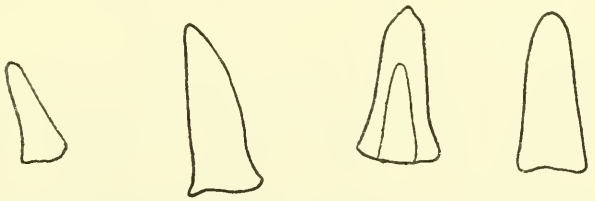

FIGURE 48.—CAREPROCTUS CYPSELURUS. TEETH FROM A SPECIMEN TAKEN OFF KAMCHATKA

Synopsis.—Dorsal 58; anal 54; pectoral 33; pyloric coeca 29–32. Depth 4.4–5.2 in length without caudal; head 4.4–4.7. Eye 4–4.7 in head; disk smaller, 4.8–6.1. Body moderately heavy anteriorly, attenuate posteriorly. Head broad and heavy. Teeth rather short and stout, simple or a few with the lateral lobes faintly indicated. Gill slit above pectoral. Caudal deeply forked. Pectoral fin with a very shallow notch; the lower lobe 1.8 in the head. Disk triangular, the posterior margin folded over. Anterior part of body and head pale to dusky; posterior part of body black; mouth and gill cavity dusky; peritoneum blackish. Four specimens known, reaching a length of 260 mm.

Remarks.—Note from a specimen from *Albatross* Station 5015, Okhotsk Sea. Depth 4.4; head 4.7. Disk 6.1 in head. Teeth slender, a few with weak cups. Pyloric coeca 32, 2.3 in the head. Disk triangular; the flap curled over the center; tip of mandible to disk 3 in head. Color purplish black, darker posteriorly; margin of pectoral black; mouth dusky. In life, greater part of head, body, and fins deep purplish indigo, the anterior part of the sides almost clear red, with little blue; head again becoming deeper blue, but with more red than the posterior part of the trunk; basal portion of upper pectoral rays also with more reddish.

The specimen from Station 4797 has the anterior part of the body pale and the posterior part black. Ninth and tenth pectoral rays slightly shortened.

CAREPROCTUS ABBREVIATUS, new species

Type.—Female, No. 3082, Stanford University Zoological Museum; south of the Alaska Peninsula, *Albatross* Station 3338; depth 625 fathoms. Length 53 mm.

FIGURE 49.—CAREPROCTUS ABBREVIATUS. TEETH FROM TYPE

Distribution.—Known only from type locality.

Relationships.—*Careproctus abbreviatus* is readily distinguished from all the species with which it might be confused by the small number of fin rays. The type specimen was labeled *C. colletti* and resembles this species in the shape of the disk and general appearance.

Description of type.—Dorsal 39; anal 32; pectoral 21. Depth 4.3 in length without caudal; head 4.3 Eye 3.4 in head, disk 3.8.

Body short, moderately deep and compressed, tapering to the caudal fin, not attenuate. Head deep, much compressed; occiput high; profile rather steep; cheeks vertical; mouth terminal; maxillary reaching beneath the pupil. Teeth simple, conical, short, in a narrow oblique band. Snout truncate, deep. Nostril in a short tube directly in front of the eye. Eye moderate, black; pupil round. Gill slit small, 3.8 in head, above the pectoral. No prickles.

Dorsal normal; the anterior rays not buried in thick tissue, not projecting. Caudal mutilated. Pectoral rays widely spaced; the upper lobe of 15 rays, not reaching the anal fin; the notch shallow; the lower lobe short reaching the vent, 2 in the head, the rays about half

free. Disk very deeply cupped; the central portion hidden in a pit formed by the thick, stiff flap; tip of mandible to disk 7.9 in the length without caudal. Vent a short distance behind the disk.

Coloration: Body pale; skin thin and lax; flesh becoming brownish toward the caudal; mouth and gill cavity pale; peritoneum and stomach nearly black.

Synopsis.—Dorsal 39; anal 32; pectoral 21. Disk deeply cupped, 3.8 in head. Gill slit above the base of the pectoral. Teeth simple, conical, short. Body pale, becoming brownish toward the caudal; peritoneum nearly black. One specimen, 53 mm. in length.

CAREPROCTUS BATHYCOETUS Gilbert and Burke

Careproctus bathycoetus GILBERT and BURKE, 1912*b*, p. 368.

Type.—Female, No. 73337, U.S.N.M.; *Albatross* Station 5030, southern part of the Okhotsk Sea; depth 1,800 fathoms. Length 181 mm.

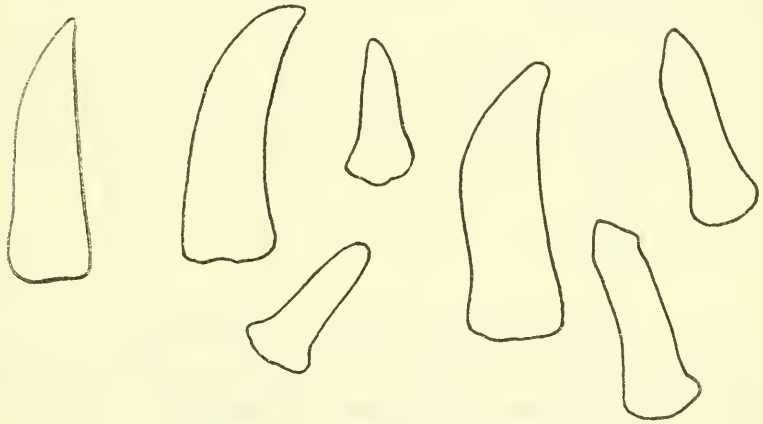

FIGURE 50.—CAREPROCTUS BATHYCOETUS. TEETH FROM TYPE

Distribution.—Southern portion of the Okhotsk Sea; *Albatross* Station 5030; depth 1,800 fathoms. One specimen known.

Relationships.—*C. bathycoetus* is readily distinguished by the reduced number of pectoral rays, the coloration, and the attenuate body.

Synopsis.—Dorsal 61; anal 55; pectoral 21; caudal 6; pyloric coeca 9. Depth 5.7 in length without caudal; head 5. Eye 4.8 in head; disk 6.9. Body very attenuate posteriorly; the posterior fourth of the body not as deep as the diameter of the eye. Teeth simple, rather stout, recurved. Gill slit above the base of the pectoral fin. Anterior mandibular pores separated by the diameter of the pupil. Lower lobe of the pectoral 1.5 in the head. Disk small, deeply cupped. Color black; lips of the pores and the ventral surface of the disk black; peritoneum black; stomach pale.

Remarks.—In the reduction of the pyloric coeca and pectoral rays and the slender body this species most closely resembles the typical *Paraliparis*. It could not, however, have given rise to the latter group of species because the primitive *Paraliparis* had trilobed teeth.

CAREPROCTUS LONGIFILIS Garman

Careproctus longifilis GARMAN, 1892, p. 9; 1899, p. 115, pls. 27–29.

Type.—No. 28703, M. C. Z.; *Albatross* Station 3374, Pacific Ocean off Panama; depth 1,823 fathoms.

Distribution.—Pacific Ocean, off Panama, *Albatross* Station 3374; depth 1,823 fathoms. One specimen known.

Relationships.—*C. longifilis* is not closely allied to any known species. It is readily distinguished from the other species of the genus by the extremely elongate upper and lower pectoral lobes and the rudimentary condition of the middle pectoral rays. *C. longifilis* parallels certain species of *Paraliparis* in the reduction in length of the middle pectoral rays.

FIGURE 51.—CAREPROCTUS LONGIFILIS. TEETH FROM TYPE

Description of type.—The type is mutilated beyond description. The following notes were taken from what remains.

Body tapering rapidly to the caudal. Head broad and heavy as in *C. melanurus;* interorbital flattened. Mouth broad; maxillary reaching vertical from pupil. Teeth rather stout and blunt, slightly recurved, in narrow bands; outer teeth smaller; the lateral lobes faintly indicated. Snout broadly rounded; upper jaw slightly longer than the lower. Nostril in a short tube. Eye small, black, about 4.7 in head. Gill slit apparently above the pectoral fin. Pores apparently normal; the upper pores on the snout nearly on a line with the nostrils.

Caudal well developed, of 8 or 10 slender rays. Pectoral fin divided to the base, thus differing from all other species of the genus; the two lobes connected by four widely spaced rudimentary rays; the upper pectoral ray extremely elongate, half the body length without caudal; the lower lobe of four elongate free rays, considerably longer than the head, reaching past the front of the anal and beyond

the middle of the upper pectoral ray. Disk small, cupped; about equal to the eye, 4.5 in the head; the flap narrow, suspended as in *C. colletti*; anterior edge of the disk under the posterior margin of the eye. Vent distant a little less than the diameter of the disk.

Color black; peritoneum black; stomach absent.

The following note is extracted from the orignal description.

Dorsal 54; A. 49; P. 13+4+4; C. 9. Head less than one-fifth the total length. Gill opening narrow, as wide as the eye, above the pectoral fin. Dorsal and anal overlapping the caudal for more than half its length. Longest pectoral ray at the upper edge of the fin, equal to four-tenths the total length of the specimen; the upper lobe of 13 rays, graduated in length, connected with the lower lobe by four shorter, widely separated rays; the lower lobe contains four separated rays, of which the third and fourth, provided with long filaments, are nearly three-tenths of the total length; the rays are more rigid than those of the species of *Paraliparis* and the ends are slender and flexible. Intense black, uniform over head, body, and fins. Total length 3¾ inches.

Synopsis.—Dorsal 54; anal 49; pectoral 21; caudal 9. Head heavy and broad, less than one-fifth the total length. Eye about 4.7 in the head; disk 4.5, cupped. Gill slit above the base of the pectoral fin. Pectoral fin divided to the base; the middle rays rudimentary; the upper lobe equal to half the length of the body without the caudal; the lower lobe about one-third the body length. Color black; peritoneum black. One specimen, length 3¾ inches.

CAREPROCTUS OVIGERUM (Gilbert)

Bathyphasma ovigerum GILBERT, 1896, p. 448.—JORDAN and EVERMANN, 1898, p. 2128, fig. 767.

Type.—Male, No. 48622, U.S.N.M.; *Albatross* Station 3342, off British Columbia; depth 1,588 fathoms; temperature 35.3° F. Length 318 mm.

Distribution.—Off British Columbia, *Albatross* Station 3342; depth 1,588 fathoms. One specimen known.

Relationships.—*C. ovigerum* does not appear to be closely allied to any known species. It is distinguished by the simple, slender, lanceolate teeth, the heavy body, the gill slit extending down in front of the pectoral fin, and the large disk. In the width of the head, the size of the eye, the large disk, and the shape of the body this species bears a close resemblance to the typical species of *Liparis*. The simple, slender, teeth, the single nostril, the anterior position of the disk, and the coloration indicate a close kinship with Careproctus with which we place the species. Gilbert, (1896, p. 448), proposed the genus *Bathyphasma* to include this species and based his genius upon the simple, lanceolate teeth which he believed to have been derived along a different line of development from that which gave rise to the simple teeth of *Careproctus*. At present we are not justified in recognizing the genus *Bathyphasma* as the denti-

tion of ovigerum grades imperceptably into that of a number of species of *Careproctus*. The genus *Careproctus*, as at present recognized, is probably a polyphyletic one but with our present knowledge we certainly are not justified in dividing it.

Description of type.—Dorsal 43; anal 34; pectoral 34; caudal 10; pyloric coeca 19. Depth 3.7 in length without caudal; head 3.5. Eye 6 in head; disk 2.9.

Body rather deep at the nape; moderately elongate and compressed, tapering gradually to the caudal. Head wide, heavy; width nearly equal to the depth; cheeks swollen; profile concave over eye, rising rapidly at the occiput; occiput slightly swollen; interorbital wide; internostril 3.7 in the head. Mouth broad; lateral cleft considerable; angle of mouth reaching vertical from front of

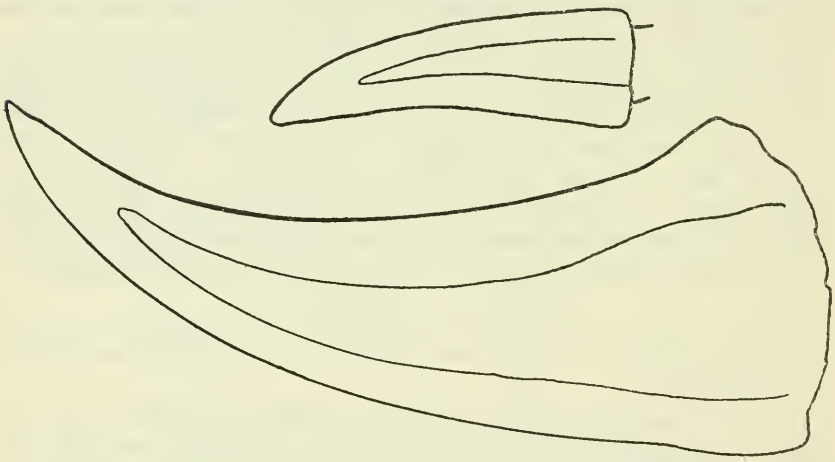

FIGURE 52.—CAREPROCTUS OVIGERUM. TEETH FROM TYPE

eye; maxillary reaching vertical from posterior margin of eye. Teeth in broad bands, simple, slender; oblique rows widely spaced, about 15 in the half of each jaw; inner teeth lanceolate, distinctly recurved; outer teeth much smaller. Snout short, comparatively deep, abrupt, not projecting beyond mouth; upper jaw slightly overlapping lower. Nostril single, apparently in a short tube. Eye moderate, not prominent; pupil large, round. Gill slit wide, 2.4 in the head, extending down in front of eight pectoral rays. The number of pores on the head uncertain as the skin is in poor condition; one suprabranchial pore detected. No prickles. Pyloric coeca 19, on the right side.

Origin of dorsal above the base of the pectoral fin; some of the anterior rays unsegmented. Caudal broad, connected for two-fifths its length to the anal; the connections between the three vertical fins abrupt, not notched. Pectoral notched; the lower lobe reaching

nearly to the vent, 1.8 in head. Disk large; the flap broad but not equal to the center of the disk; disk well forward under the head; distance from tip of lower jaw to disk 7.2 in length without caudal. Vent separated from the disk by two-thirds diameter of disk, twice as far from the anal fin.

Color pale, dusted with light brown; abdomen dusky; peritoneum dusky, possibly silvery in life.

Synopsis.—Dorsal 43; anal 34; pectoral 34; caudal 10; pyloric coeca 19; body and head heavy, somewhat resembling that of *Liparis agassizii*; depth 3.7 in length without caudal; head 3.5. Eye 6 in head; disk 2.9. Teeth simple, lanceolate. Gill slit extending down in front of eight pectoral rays. Dorsal fin unnotched. Pectoral fin notched; the lower lobe reaching nearly to the vent, 1.8 in the head. Disk large, well forward under the head. Color pale,

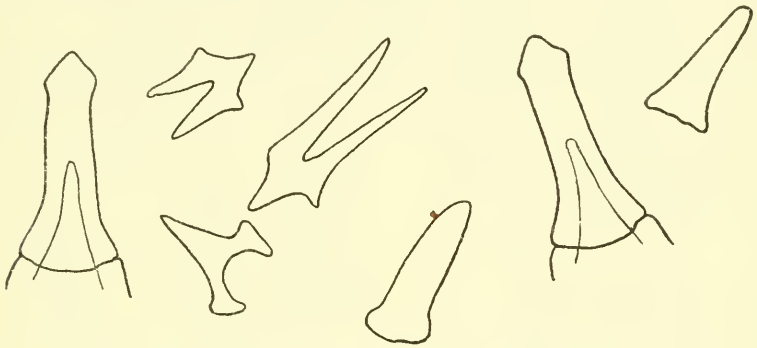

FIGURE 53.—CAREPROCTUS OPISTHOTREMUS. TEETH FROM TYPE

dusted with light brown; peritoneum dusky, possibly discolored. One specimen, 318 mm. in length.

CAREPROCTUS OPISTHOTREMUS Gilbert and Burke

Careproctus opisthotremus GILBERT and BURKE, 1912*a*, p. 78.

Type.—No. 74385, U.S.N.M.; *Albatross* Station 4780, among the Aleutian Islands, Bering Sea; depth 1,046 fathoms. Length 50 mm.

Distribution.—Among the Aleutian Islands, *Albatross* Station 4780; depth 1,046 fathoms. One specimen known.

Relationships.—*C. opisthotremus* does aot appear to be closely allied to any known species. It is distinguished by the slender, depressed body, the position of the vent, and the gill slit extending down in front of the pectoral fin.

Synopsis.—Dorsal 46?; anal 36?; pectoral 32; pyloric coeca 12. Body slender, elongate, head depressed; depth of body 6 in length without caudal; head 3.5. Eye 4.7 in head; disk 3.4, flat. Teeth simple, or few of the larger teeth with distinct lateral lobes. Gill slit extending down in front of five pectoral rays. Pectoral fin notched;

the lower lobe 2 in head, reaching midway between disk and vent. Vent nearer the anal fin than the disk; disk to vent 2.4 in the head. Color probably pale. One specimen, 50 mm. in length.

CAREPROCTUS LONGIPINNIS Burke

Liparis reinhardi Lütken, 1898, p. 14, pl. 3, fig. 3.3*a*, (part, not of Kröyer).—Collett, 1905, p. 97, pl. 2, fig. 7, (part, not of Kröyer).

Careproctus longipinnis Burke, 1912*b*, p. 509.

Distribution.—Arctic Ocean, Faroe Islands to Beeren Island. Type from "Ingolf Station 139, north of the Faroe Islands; depth 702 danish fathoms." Figured by Lütkin as *L. reinhardi* in "Danish Ingolf Expedition, vol. 2, pt. 1, The Ichthyological Results, pl. 3, figs. 3–3*a*."

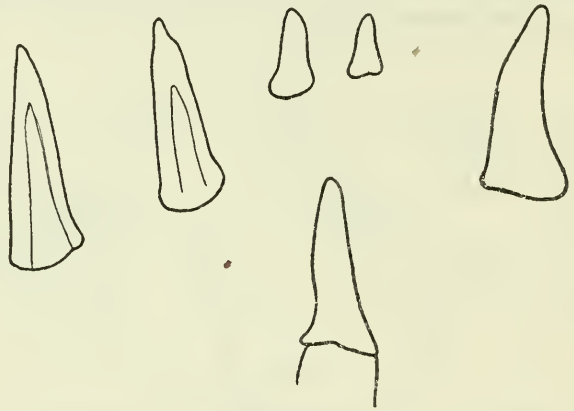

Figure 54.—Careproctus pellucidus. Teeth from type

Relationships.—*C. longipinnis* differs from all the other species of the genus from the same region in the deeper body, the longer lower lobe of the pectoral, and the more deeply cupped disk.

Synopsis.—Dorsal 53; anal 44; pectoral 30–31; caudal 10. Body gelatinous, deep; depth of body greater than length of head. Head 4.9 in total length. Eye 5 in head. Disk 4.6. Gill slit above the base of the pectoral fin. Pectoral fin unnotched; lower lobe elongate, exceeding the length if the head by a little more than the diameter of the eye. Disk small, cupped and triangular; posterior margin folded over. Vent close to disk.

CAREPROCTUS PELLUCIDUS Gilbert and Burke

Careproctus pellucidus Gilbert and Burke, 1912*b*, p. 366.

Type.—Female, No. 73335, U.S.N.M.; *Albatross* Station 5048, off Kinka San, Japan; depth 129 fathoms. Length 128 mm.

Distribution.—Northeast coast of Hondo, Japan, *Albatross* Stations 5048 and 5049; depth 129–182 fathoms. Seven specimens examined, reaching a length of 128 mm.

Relationships.—*C. pellucidus* bears a close resemblance to *C. trachysoma*. It has a larger eye, the gill slit extending more distinctly down in front of the pectoral fin, the fin rays different in number, the peritoneum undotted, and no prickles. It seems unlikely that this species represents specimens of *C. trachysoma* in which the prickles are absent.

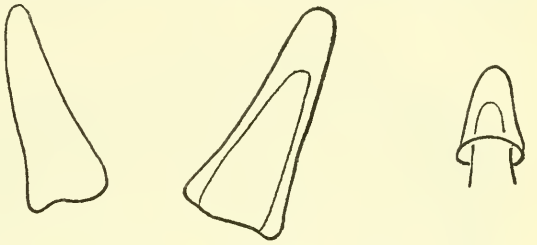

FIGURE 55.—CAREPROCTUS ACANTHODES. TEETH FROM TYPE

Synopsis.—Dorsal 54–55; anal 48–49; pectoral 33–35; caudal 7–8; pyloric coeca 18–22. Depth 3.5 in length without caudal; head 3.9. Eye 3.7 in the head; disk 7; lower lobe of the pectoral fin 1.2–1.4. Body short, deep and compressed. Teeth simple, and slender. Gill slit extending down in front of five or six pectoral rays. No prickles. Disk small, cupped, somewhat triangular. Color pale; peritoneum undotted.

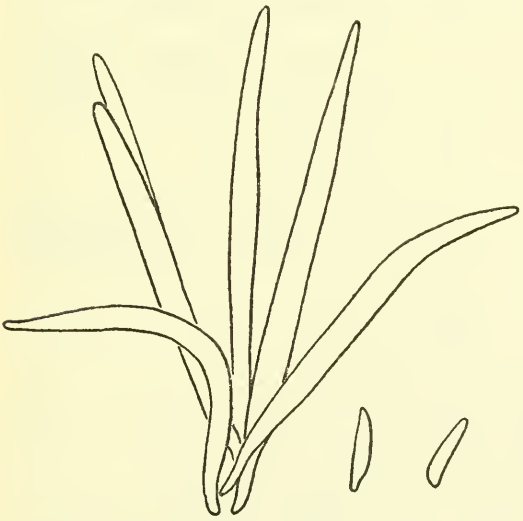

FIGURE 56.—CAREPROCTUS ACANTHODES. PRICKLES FROM TYPE

CAREPROCTUS ACANTHODES
Gilbert and Burke

Careproctus acanthodes GILBERT AND BURKE, 1912*b*, p. 363.

Type.—Female, No. 73332, U.S.N.M.; *Albatross* Station 4997, Gulf of Tartary; depth 318 fathoms; temperature 32.8° F. Length 89 mm.

Distribution.—Gulf of Tartary, *Albatross* Station 4997; depth 318 fathoms. Five specimens examined, reaching a length of 89 mm.

Relationships.—*C. acanthodes* closely resembles *C. rastrinus* and *C. spectrum;* differing from *C. rastrinus* in the shape of the head, larger eye, smaller gill slit?, the silvery coloring of the eye?, and the smaller number of fin rays; differing from *C. spectrum* in the presence of cactuslike prickles and the much shorter, lower pectoral lobe.

Synopsis.—Dorsal 52–53; anal 45–46; pectoral 33–34; caudal 8; pyloric coeca 19. Depth 3.6–3.7 in length without caudal; head 3.5.

Eye 3.5–4 in head; disk 4.5–4.8; lower lobe of the pectoral fin 1.8–2. Body rather deep and compressed. Teeth simple. Eye moderate, the lower half silvery. Gill slit either above the pectoral fin or extending down in front of the upper ray. Cactuslike prickles present. Lower pectoral lobe short, about 2 in the head, reaching

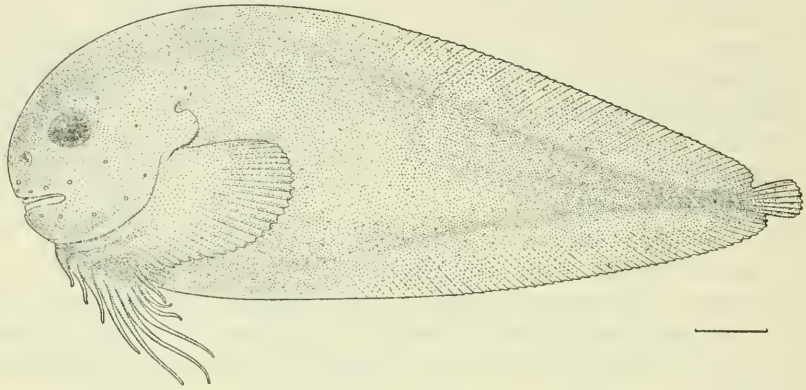

FIGURE 57.—CAREPROCTUS RASTRINUS. TYPE. SHOWING THE GREAT DEVELOPMENT OF THE HEAD REGION CHARACTERISTIC OF SOME SPECIES OF THE GENUS

little past the vent. Disk small, cupped, somewhat triangular. Body translucent, dotted with brown; peritoneum silvery, undotted.

CAREPROCTUS RASTRINUS Gilbert and Burke

Careproctus rastrinus GILBERT and BURKE, 1912*b*, p 362.

Type.—Female, No. 73331, U.S.N.M.; *Albatross* Station 5026, southern part of Okhotsk Sea; depth 119 fathoms. Length 280 mm.

Distribution.—Southern part of the Okhotsk Sea, off the coast of Sakhalin. *Albatross* Stations 5021 and 5026; depth 73 and 119 fathoms. Three specimens examined.

Relationships.—*C. rastrinus* agrees with *C. acanthodes* and *C. trachysoma* in the presence of cactuslike prickles and in most other respects. These three species inhabit neighboring or overlapping regions. (See descriptions of *C. acanthodes* and *C. trachysoma*).

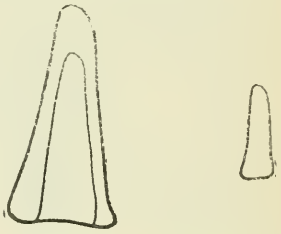

FIGURE 58.—CAREPROCTUS RASTRINUS. TEETH FROM TYPE

Description of type.—Eye moderate, not especially prominent, black; pupil small, round. Gill slit 3.4 in the head, extending down in front of four pectoral rays. Suprabranchial pores 2, close together; rudimentary pores on the top of the head and along the median line of the sides; upper snout pores nearly between the nostrils; other pores normal. Cactuslike prickles on the body and fins, more scattered toward the caudal, none on the chin and lips; these prickles

may be in groups of as many as 12 or more. Pyloric coeca 1.7 in the head, on the left side.

Origin of the dorsal over the gill slit; the anterior third of the rays buried beneath the fin membranes; the rays increasing rapidly in length. Anal similar to the dorsal. Caudal slightly rounded, composed of stout rays, connected for three-fifths of its length to the anal; dorsal and anal connections with the caudal abrupt. Pectoral deeply notched; the lower lobe of thickened, partly free, exerted rays, reaching the anal and extending back nearly as far as the uper lobe, nearly equal to the head; in the small specimen shorter, 1.6 in the head. Disk small, hidden in a depression between the lower pectoral lobes, slightly cupped, triangular, as wide as long; the flap thickened and suspended, posteriorly folded over the center; tip of mandible to disk 10.2 in the length without caudal. In the small specimen the disk is more prominent and slightly triangular. Vent next to the disk.

Color: Opaque white; pores on the sides yellowish; stomach and part of the intestines dotted; peritoneum silvery; coeca dusky at the base.

Synopsis.—Dorsal 58–59; anal 52; pectoral 34–37; caudal 8; pyloric coeca 21–34. Depth 2.8–3.3 in length without caudal; head 3.5. Eye 4.6–4.8 in the head; disk 3.7 in the young to 7.8 in the adults; lower lobe of the pectoral 1.1 in the adults and 1.6 in the young. Body deep, shorter than in *C. acanthodes* and *C. trachysoma*. Teeth simple, moderately stout. Eye moderate, black in all our specimens. Gill slit extending down in front of four or five pectoral rays. Cactuslike prickles present. Lower lobe of the pectoral fin reaching to the origin of the anal fin, nearly equal to the head in the adults, 1.6 in the head in the young. Disk small, slightly cupped and triangular; tip of mandible to disk 9.6 to 10.8 in the length without the caudal. Body opaque, white, pinkish in life, peritoneum silvery, undotted; stomach pale, dotted or not. Three specimens, the largest 280 mm., the smallest 84 mm. in length.

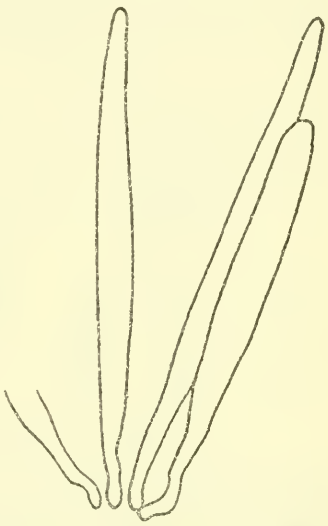

FIGURE 59.—CAREPROCTUS RASTRINUS. PRICKLES FROM TYPE

CAREPROCTUS TRACHYSOMA Gilbert and Burke

Careproctus trachysoma GILBERT and BURKE, 1912*b*, p. 364.

Type.—Male, No. 73333, U.S.N.M.; *Albatross* Station 4982, Japan Sea; depth 390 fathoms. Length 263 mm.

Distribution.—Japan Sea, and Gulf of Tartary, *Albatross* Stations 4814, 4981, 4982, 4983, 4992, and 4997; depth 318 to 429 fathoms. Thirteen specimens examined, reaching a length of 263 mm.

Relationships.—*C. trachysoma* appears to be closely allied to *C. acanthodes* and *C. rastrinus;* distinguished from *C. acanthodes* by the dotted peritoneum, smaller disk, narrower head, more fin rays, and the longer lower pectoral lobe; from *C. rastrinus* by the larger eye, the dotted peritoneum, the depth and shape of the body, and the smaller number of pectoral rays; from *C. melanurus* in the larger gill slit, coloration, and the presence of prickles. (See description of *C. pellucidus.*)

Synopsis.—Dorsal 58–60; anal 53–55; pectoral 31–32; caudal 7–8; pyloric coeca 20. Depth of body 3.5–4.1 in length without caudal; head 3.7–4.6; tip of mandible to disk 8.5–11. Eye 3.8–4.2 in head; disk 7.5–8.3 in large specimens, 5.8 in young; lower lobe of the pectoral

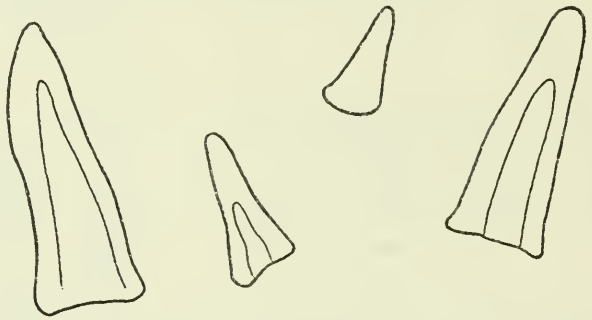

FIGURE 60.—CAREPROCTUS TRACHYSOMA. TEETH FROM COTYPE

fin 0.9 in adults, 1.3 in young. Body moderately deep, more elongate than in *C. rastrinus.* Teeth simple. Eye moderate, the lower half silvery or black. Gill slit normally extending down in front of from one to five pectoral rays. Cactuslike prickles present. Lower pectoral lobe elongate, reaching nearly to the anal fin, about equal to the head. Disk small, slightly cupped; the margin in front and behind folded over. Body dusky gray, bluish black posteriorly; lips dusky; peritoneum silvery, dotted; stomach blackish.

CAREPROCTUS GILBERTI Burke

Careproctus spectrum BEAN, 1890, p. 40 (part, confused with type of *C. spectrum.*—EVERMANN and GOLDSBOROUGH, 1907, p. 333 (part, not of Gilbert.)—GILBERT and BURKE. 1912*a*, p. 76.

Careproctus gilberti BURKE, 1912*a*, p. 568.

Type.—No. 64110, U.S.N.M.; north of Kodiak Island, Alaska, *Albatross* Station 4292; depth 102 fathoms.

Distribution.—Off British Columbia and southeastern Alaska, *Albatross* Stations 2848, 2862, 3480, 4292, 4293, and 4781; depth 102 to 482 fathoms. Thirty specimens examined.

Relationships.—*Careproctus gilberti* closely resembles *Careproctus ostentum.* Specimens of *Careproctus gilberti* were found in the type

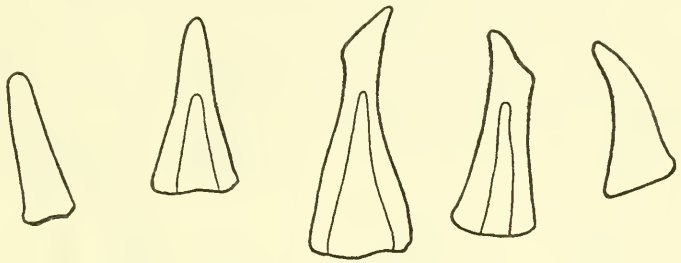

FIGURE 61.—CAREPROCTUS GILBERTI. TEETH FROM TYPE

bottle of *Careproctus spectrum* indicating that these species closely resemble each other. *Careproctus gilberti* can be distinguished from *C. ostentum* by the distinctly larger disk and from *C. spectrum* by the smaller disk, wider gill slit and the darkly colored stomach.

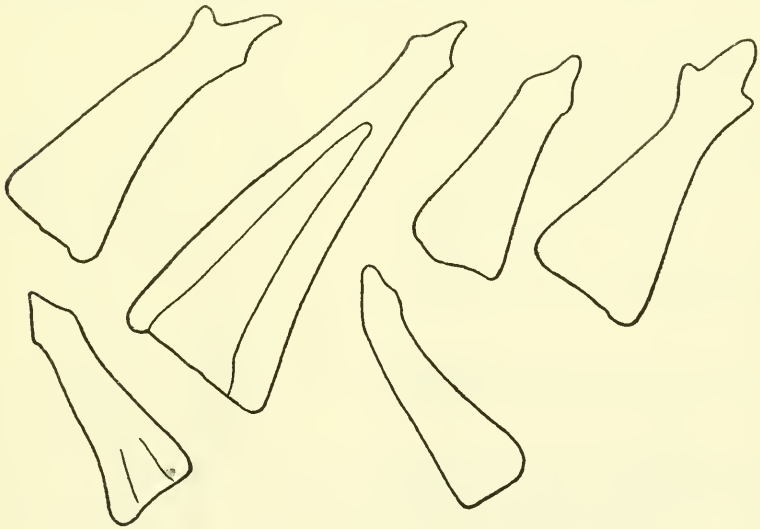

FIGURE 62.—CAREPROCTUS GILBERTI. TEETH FROM COTYPE

Synopsis.—Dorsal 55; anal 46–48; pectoral 31; pyloric coeca 10–12. Disk 7.3–9 in head, small and deeply cupped. Gill slit extending down in row of 14 pectoral rays. Teeth simple or a few with lateral lobes. Color pale or pinkish; peritoneum silvery; stomach blackish.

CAREPROCTUS OSTENTUM Gilbert

Careproctus ostentum GILBERT, 1896, p. 444.

Type.—Female, No. 48619, U.S.N.M.; *Albatross* Station 3324, north of Unalaska, Bering Sea; depth 109 fathoms.

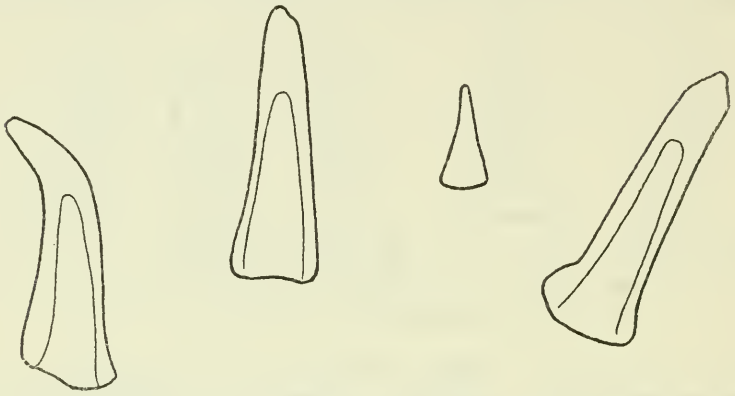

FIGURE 63.—CAREPROCTUS OSTENTUM. TEETH FROM TYPE

Distribution.—Bering Sea; *Albatross* Stations 3331 and 3324; depth 109–350 fathoms. Three specimens examined, all of small size.

Relationships.—*C. ostentum* is distinguished by the minute disk. It closely resembles *C. gilberti* but has advanced a step farther toward the loss of the disk.

Description of type.—Dorsal 54; anal 47; pectoral 32; caudal 8. Depth 4.5 in length without caudal; head 3.8. Eye 3.2 in head; disk minute, more than 9 in the head.

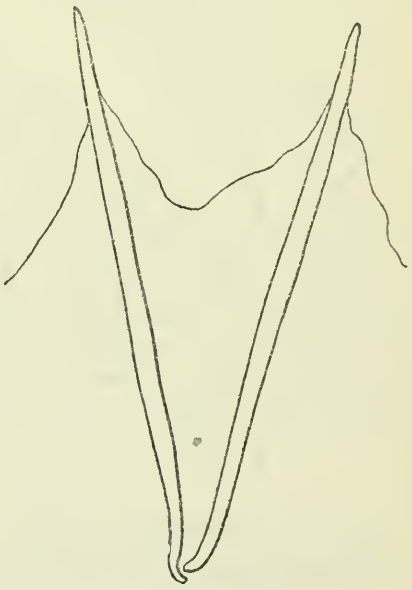

FIGURE 64.—CAREPROCTUS OSTENTUM. PRICKLES FROM SPECIMEN NO. 3023, STANFORD UNIVERSITY ZOOLOGICAL MUSEUM

Body rather heavy at the nape, short, slender posteriorly. Head heavy; interorbital broad, flat; occiput slightly swollen; cheeks vertical. Mouth broad, lateral cleft reaching vertical from pupil: maxillary reaching vertical from posterior margin of eye. Teeth simple, numerous, inner teeth elongate, slender, recurved; the oblique rows difficult to count, about 10 in the half of the lower jaw. Snout low, profile retreating gradually from the mouth; upper teeth partly exposed when the jaws are closed. Nostril in a very short tube. Eye large, promi-

nent, black, the lower half probably silvery in life; pupil large, round. Gill slit in front of 12 pectoral rays. Pores 2–6–7–2. Pyloric coeca about 10. No prickles on type; cactuslike prickles on specimen No. 3023, these may be isolated or in groups of 10 or 12 or more.

Anterior dorsal rays short, buried in tissue beneath the skin. Pectoral fins very oblique, the symphysis under the front of the eye, the notch broad, bridged by 10 shortened, widely spaced rays; 17 rays above the notch; the lower lobe of 5 delicate rays, reaching midway to anal fin. Disk absent from the type, in specimen No. 695 minute, perfect in structure, hidden between the pectoral lobes. Caudal slender, of eight rays.

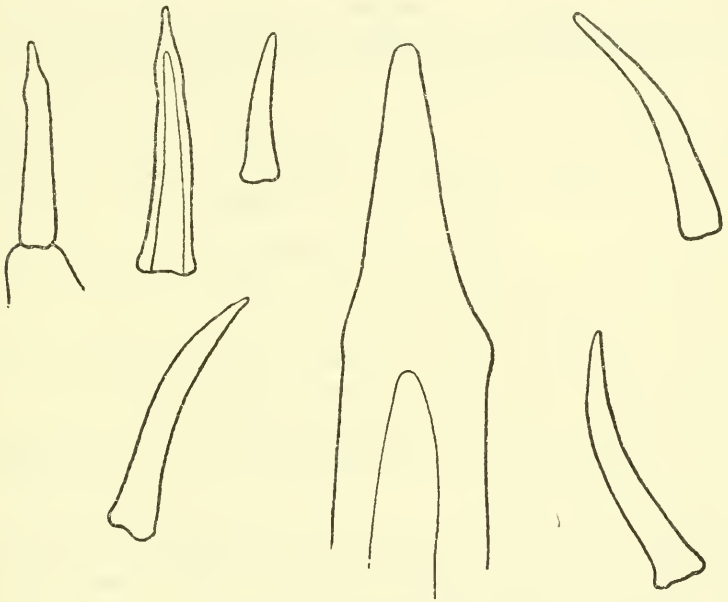

FIGURE 65.—CAREPROCTUS ROSEOFUSCUS. TEETH FROM TYPE

Color pale; peritoneum silvery with black dots; mouth and gill cavity pale; stomach black.

Synopsis.—Dorsal 54; anal 47; pectoral 32; caudal 8; pyloric coeca 10. Depth 4.5 in length without caudal; head 3.8; lower lobe of the pectoral fin 1.8. Body rather heavy anteriorly, short. Teeth simple, slender, elongate and recurved. Gill slit extending down in front of 12 pectoral rays. Cactuslike prickle present or absent. Disk minute, apparently perfect in shape and structure, more than 9 in the head. Body pale, peritoneum silvery, dotted; stomach black.

CAREPROCTUS ROSEOFUSCUS Gilbert and Burke

Careproctus roseofuscus GILBERT and BURKE, 1912*b*, p. 369.

Type.—No. 73338, U.S.N.M.; *Albatross* Station 5026, southern part of the Okhotsk Sea; depth 119 fathoms; length 91 mm.

Distribution.—Okhotsk Sea, off Saghalin, *Albatross* Stations 5018 and 5026; depth 100 and 119 fathoms. Five specimens examined, reaching a length of 114 mm.

Relationships.—*Careproctus roseofuscus*, having s similar type of dentition, is allied to the *C. colletti* group of species. It is distinguished by the paler coloration, the greater depth of head and body and the short lower pectoral lobe.

Synopsis.—Dorsal 57–58; anal 48–49; pectoral 28–30; caudal 8; pyloric coeca 21–22; depth 4 in length without caudal; head 4–4.2; tip of mandible to disk 9.5–10. Eye 4.2–4.5 in head; disk 3.3–3.5; lower lobe of pectoral 2.1. Body comparatively deep and compressed. Teeth simple, lanceolate, considerably recurved; the anterior teeth appearing little smaller than the inner teeth; the cutting surface of the bands of teeth appearing horizontal. Gill slit above the base of the pectoral fin. No prickles. Lower lobe of the pectoral fin short, reaching nearly to the vent, 2.1 in the head. Disk oval, cupped. Body pale or pinkish; caudal and neighboring portions of dorsal and anal dusky; peritoneum black. Five specimens, reaching a length of 114 mm.

CAREPROCTUS COLLETTI Gilbert

Careproctus colletti Gilbert, 1896, p. 442.—Jordan and Evermann, 1898, p. 2131.—Gilbert and Burke, 1912*b*, p. 370.

Type.—No. 48698, U.S.N.M.; *Albatross* Station 3338, south of the Alaska Peninsula; depth 625 fathoms; length 84 mm.

Distribution.—North Pacific, Bering Sea, Okhotsk Sea and the Japan Sea; *Albatross* Stations 3325, 3338, 4982, and 5029; depth 284 to 625 fathoms; temperature 35° to 38° F. Seventeen specimens examined.

Relationships.—*C. colletti* bears a close resemblance to *C. entomelas*. It differs from the latter species in the absence of prickles, the darker coloration, the longer lower pectoral lobe, and the shorter snout.

Description of type.—Dorsal 52; anal 50; pectoral 28; caudal 6; pyloric coeca 8. Depth 5.6 in length without caudal; head 4.5. Eye 3.5 in head; disk 3.2.

Body elongate, deepest at union with head; tapering gradually. Head slender, compressed; occiput high; profile forming a straight line from tip of snout to occiput; interorbital flat. Mouth moderate, lateral cleft reaching past front of eye; maxillary reaching posterior margin of pupil. Teeth lanceolate, recurved, the cutting surface of the bands horizontal; the rows very oblique, about 11 in the half of each jaw; outer teeth smaller but with dissection, appearing almost as large as the inner teeth. Snout short, deep; jaws about equal, the lower slightly projecting. Nostril in front of the eye, the tube, very short, simply a raised rim. Eye large, black; pupil round. Gill slit small, 5.5 in the head, above the base of the pectoral fin. Supra-

branchial pores 2. No prickles. Pyloric coeca 8, nearly equal to the eye, on the left side of the body cavity.

Dorsal rays slender; the anterior rays not buried in pseudotissue, not projecting above the fin membrane. Caudal slender, truncate, connected for one-sixth its length to the anal, the connection gradual, without a notch. Upper lobe of pectoral reaching anal; the rays slender at the tips, partly free and coiled; the lower lobe of five rays graduated in length, free nearly to the base, coiled at the tips, reaching the anal, 1.1 in the head. In a small specimen the lower lobe does not reach beyond the vent. Disk oval, cupped, the margin stiff and suspended; tip of mandible to disk 9 in length without caudal. Vent distant from disk by two-thirds diameter of disk.

Coloration dusky; snout, lips, abdomen, gill cavity, and tongue dusky; caudal and dorsal and the anal black posteriorly; peritoneum black; coeca pale.

Synopsis.—Dorsal 54–57; anal 49–52; pectoral 27–29; caudal 8; pyloric coeca 8–18. Depth 3.6–6 in the length without the caudal, depending upon the size of the specimen; head 4.2–4.8. Eye 3.4–5 in the head; disk 3.2–5.3; lower lobe of pectoral 0.8–1.2. Body elongate. Teeth simple, elongate, distinctly recurved; the bands horizontal. Gill slit above the base of the pectoral fin. Lower lobe of pectoral elongate, about equal to the head, reaching backward to the anal fin in adults, in some of the small specimens not extending beyond the vent. Disk small, oval, deeply cupped. No prickles. Color dusky or gray, darker posteriorly; lips, mouth, and gill cavity dusky or black; caudal, margin of dorsal and anal, and the peritoneum black. Seventeen specimens, attaining a length of 248 mm.

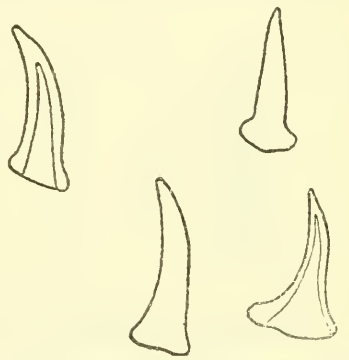

FIGURE 66.—CAREPROCTUS COLLETTI. TEETH FROM TYPE

Remarks.—In 1906 the *Albatross* collected a number of specimens of *C. colletti* in the Okhotsk and Japan Seas. These specimens differ somewhat from the types as evidenced by the following notes.

Note on small specimens less than 100 mm. in length from the Okhotsk Sea. Body elongate; depth more than 5 in the length. Teeth lanceolate, strongly recurved, the cutting surface of the bands horizontal; about 15 oblique rows in the half of each jaw; teeth in front appearing little or not at all shorter than the inner teeth. Nostril in a short tube. Snout short, bluntly rounded, slightly projecting; jaws equal. Pores 2–6–7–2; the 2 suprabranchial pores close together, the tubes of equal length; the upper pore on the snout at

the tip of the snout, distant from the nostril by the diameter of the pupil.

Caudal slender, truncate, connected for one third its length to dorsal and anal; last dorsal and anal rays not shortened. The lower lobe of the pectoral of elongate rays, these free nearly to the base; the lobe variable in length, reaching from a short distance past the vent to the anal fin, usually reaching midway between vent and anal fin.

Color dusky, darker toward the caudal; the skin transparent, lax, dusted with brown dots; lips black; flesh dotted; lower lobe of pectoral fin darker than the upper lobe; mouth and gill cavity dusky; peritoneum black; stomach white.

Note on several large specimens over 200 mm. in length. Body deeper; depth 3.6 to 4.1 in length without caudal. Lower lobe of pectoral fin longer than head, extending beyond the upper lobe and

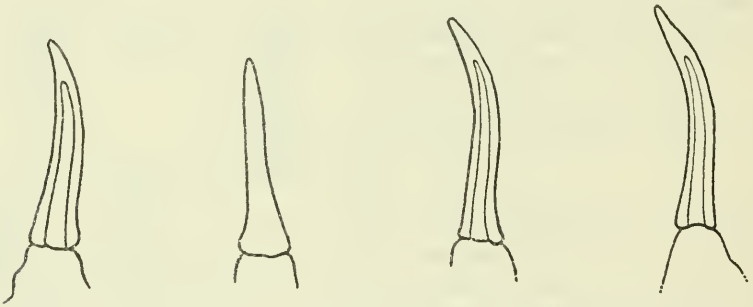

FIGURE 67.—CAREPROCTUS COLLETTI. TEETH FROM A SPECIMEN FROM ALBATROSS STATION 5029

past the origin of anal fin. Body gelatinous; anterior dorsal rays surrounded by tissue; skin lax, less dusky than in the small specimens. Color pinkish; lips black; margin of dorsal and anal and the caudal black; gill cavity dusky.

The large specimens from the Japan and Okhotsk Seas appear to belong to the same species as the specimens from Bering Sea and the Gulf of Alaska. There are no large specimens from the latter regions with which to make comparison. The large specimens differ considerably among themselves, especially in the size of the disk. The small specimens taken with the large specimens differ slightly, or not at all, from specimens of equal size taken off the coast of Alaska. It appears from the evidence we have that the species ranges from the Gulf of Alaska to the Japan Sea and that the specimens attain the greatest size in the latter and neighboring portions of its range.

The teeth of specimen No. 53033, U.S.N.M., appear to differ from the teeth examined in other specimens. The teeth of this specimen appear to be stouter and with the lateral lobes slightly developed.

The specimen is immature and may not belong with this species. The teeth may, however, be of this type in the very young.

Color in life gray, everywhere very finely punctulate with black; head, body, and fins lightly tinged with red, most pronounced on front of head and on pectoral fins; lower pectoral rays faintly barred; vertical fins anteriorly with a narrow black margin, which gradually broadens posteriorly until it involves the entire height of the fins; lips, mouth, and gill cavity dusky; the peritoneum black.

CAREPROCTUS ENTOMELAS Gilbert and Burke

Careproctus entomelas Gilbert and Burke, 1912*b*, p. 374.

Type.—No 73343, U.S.N.M.; *Albatross* Station 4983, coast of Hokkaido, Sea of Japan; depth 428 fathoms. Length 77 mm.

Distribution.—Japan Sea; *Albatross* Stations 4838 and 4983; depth 144–428 fathoms. Two specimens examined, reaching a length of 77 mm.

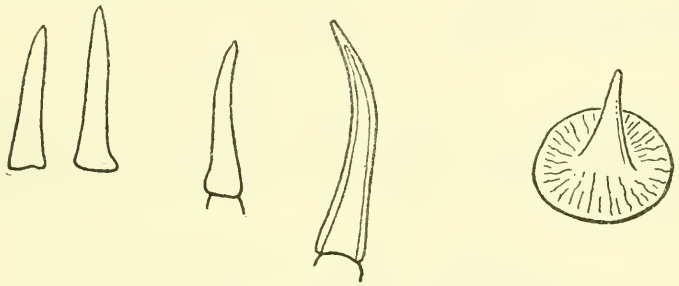

Figure 68.—Careproctus entomelas. Teeth and prickle from type

Relationships.—*C. entomelas* is allied to *C. colletti and C. entargyreus.* The dentition of these three species is similar; they agree also in most other respects. *C. entomelas* is distinguished from *C. colletti* by the lighter coloration, the deeper body?, the presence of prickles, the more projecting snout, and the shorter lower pectoral lobe; from *C. entargyreus* by the darker coloration, the larger pupil, and the distribution.

Synopsis.—Dorsal 53; anal 46; pectoral 28; pyloric coeca 19. Depth 5.5; head 4. Eye 3.5; disk 3.3; lower lobe of pectoral fin 1.4. Body elongate. Teeth lanceolate, recurved; the bands horizontal. Snout blunt, distinctly projecting. Eye moderate, pupil large, round. Gill slit above the pectoral fin or extending down in front of the base of the upper ray. Thumb-tack prickles present. Lower lobe of the pectoral fin reaching little past the vent. Disk small, cupped. Body pale, slightly dotted, more pigment posteriorly; lips pale or slightly dusky; mouth and gill cavity slightly dusky; peritoneum black.

CAREPROCTUS ENTARGYREUS Gilbert and Burke

Careproctus entargyreus Gilbert and Burke, 1912*b*, p. 375.

Type.—No. 73344, U.S.N.M.; Gulf of Tartary, *Albatross* Station 4998; depth 66 fathoms. Length 73 mm.

Distribution.—Gulf of Tartary, Japan Sea; *Albatross* Stations 4998 and 5003; depth 35 to 66 fathoms. Two specimens examined, reaching a length of 77 mm.

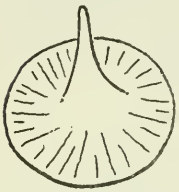

Figure 69.—Careproctus entargyreus. Prickle from type

Relationships.—*C. entargyreus* appears to be closely related to *C. entomelas*. It differs from the latter species in the smaller amount of pigment in the peritoneum, the smaller pupil and the vertical distribution.

Synopsis.—Dorsal 57; anal 49; pectoral 31; caudal 8; pyloric coeca 13. Depth 5.7 in length without caudal. Disk 2.8 in head. Gill slit above pectoral. Teeth as in *C. colletti*, simple, elongate, slender, strongly recurred. Pupil reduced to a minute pore. Color pale, mouth and gill cavity pale; peritoneum pale with black dots.

TEMNOCORA, new genus

Disk, present; nostril single; teeth trilobed; suprabranchial pores 2; pyloric coeca present; pupil slitlike; dorsal fin notched; branchiostegal rays 6.

Genotype.—*Temnocora candida.*

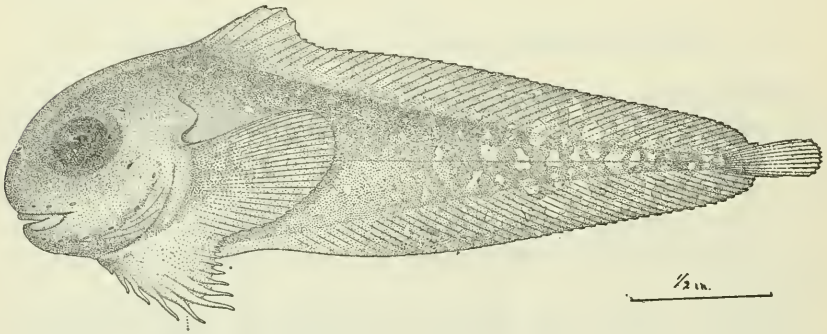

Figure 70.—Temnocora candida. Type, showing the notched dorsal and slitlike pupil

TEMNOCORA CANDIDA (Gilbert and Burke)

Careproctus candidus Gilbert and Burke, 1912*a*, p. 77.

Type.—No. 74384, U.S.N.M.; *Albatross* Station 4784, off Attu Island, Bering Sea; depth 135 fathoms. Length 72.5 mm.

Distribution.—Bering Sea, *Albatross* Station 4784; depth 135 fathoms. Four specimens examined, reaching a length of 76 mm.

Synopsis.—Dorsal 45–48; anal 39; pectoral 33–37; pyloric coeca 20. Depth 3.7 in length without caudal; head 3.5–3.8. Eye 2.8 in

head; disk 2.9–3.4; lower lobe of pectoral fin 1.5. Body short, deep. Teeth strongly trilobed. Eye large, prominent; pupil reduced to a horizontal slit. Gill slit above the pectoral fin. Dorsal fin distinctly notched. Disk well developed, flat. Color white or pinkish; peritoneum pale.

Genus CRYSTALLICHTHYS Jordan and Gilbert

Crystallichthys Jordan and Gilbert, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2864.

Disk present; nostril single; teeth trilobed; suprabranchial pores one or two; pyloric coeca present; pseudobranchiae absent; branchiostegal rays 6; pupil reduced to a slit; body with roundish or irregular blotches.

Genotype.—*Crystallichthys mirabilis.*

CRYSTALLICHTHYS CYCLOSPILUS Gilbert and Burke

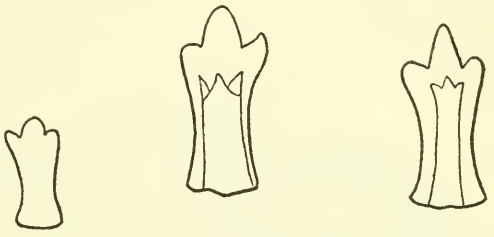

Figure 71.—Temnocora candida. Teeth from type

Liparis cyclostigma Gilbert, 1896, p. 446 (part, confused with *Liparis cyclostigma.*—Jordan and Evermann, 1898, p. 21-25.—Jordan and Gilbert, 1899, (part, after Gilbert).—Evermann and Goldsborough, 1907, p. 333, pl. 19 (part).

Crystallichthys mirabilis Jordan and Gilbert, 1899, p. 476, pl. 76 (part).

Crystallichthys cyclospilus Gilbert and Burke, 1912*a*, p. 74.

Type.—No. 74381, U.S.N.M.; *Albatross* Station 4779, Bering Sea; depth 54 fathoms. Length 200 mm.

Distribution.—Bering Sea, *Albatross* Stations 3252, 3439, 3638, 4777, and 4779; depth 29–52 fathoms. Twelve specimens examined, reaching a length of 200 mm.

Relationships.—*C. cyclospilus* closely resembles *C. mirabilis.* These two species agree in most respects, particularly in having a peculiar pupil and blotched coloration. *C. cyclostigma* can be distinguished from *C. mirabilis* by the shorter rounded snout, the broader head, the more rounded pinkish blotches, and the snout not divided on the lower surface.

Synopsis.—Dorsal 48–50; anal 42–43; pectoral 33–35; caudal 10; pyloric coeca 36. Depth 3.1–3.8 in length without caudal; head 3.6–3.8. Eye 6–7 in the head; disk 2.2–2.4. Body deep and much compressed, moderately elongate. Teeth stout, blunt, distinctly trilobed. Snout short, deep, broadly rounded, not projecting. Eye small; pupil elliptical, partially divided dorsally by a projection from the iris. Gill slit above the pectoral fin. Disk normal, large. Body whitish in alcohol, pinkish in life, large roundish, pinkish blotches on head, body, and fins; peritoneum pale.

CRYSTALLICHTHYS MIRABILIS Jordan and Gilbert

Crystallichthys mirabilis Jordan and Gilbert, 1898, p. 2864 (part).—1899, p. 476, pl. 75 (part).—Evermann and Goldsborough, 1907, p. 333, pl. 20.—Gilbert and Burke, 1912*a*, p. 75.

Type.—Female, No. 51466, U.S.N.M.; *Albatross* Station 3643, off. the southeast coast of Kamchatka; depth 100 fathoms. Length 330 mm.

Distribution.—Southeast coast of Kamchatka, *Albatross* Stations 3643 and 4794; depth 58 to 100 fathoms. Two specimens examined, the largest 330 mm.

Relationships.—*C. mirabilis* is closely related to *C. cyclospilus.* It can be distinguished from the latter species by the more compressed head, the long conical divided snout, and the coloration.

Description of type.—Body gelatinous, deep and compressed; depth 3.7 in length without caudal; body tapering very slowly,

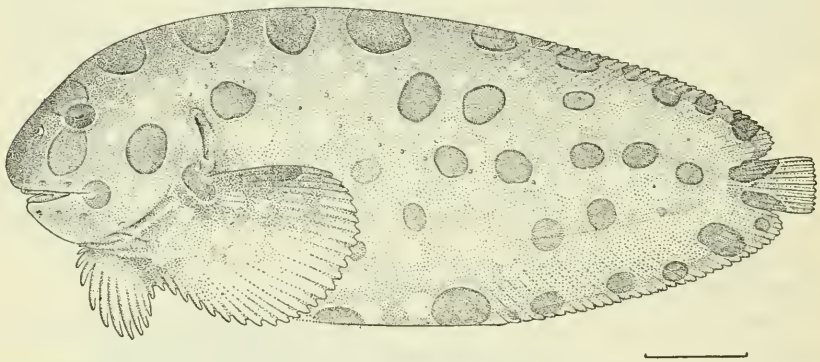

Figure 72.—Crystallichthys cyclospilus. Type, showing peculiar pupil and blotched coloration

holding the depth past the middle then descending rapidly to the caudal. Head much compressed, the sides nearly vertical; profile in an even curve; interorbital narrow; occiput not swollen. Mouth beneath the snout, small; maxillary reaching vertical from posterior margin of pupil. Teeth stout, blunt, distinctly trilobed, in broad bands, close set; outer teeth smaller. Snout divided longitudinally on the lower surface, conical, a somewhat rigid fold within the cleft, tapering sharply and projecting beyond mouth. Nostril single, in a prominent tube. Eye moderate, 5 in the head; pupil elliptical, partially divided as in *C. cyclospilus;* eye black. Gill slit small, 4.6 in head, above the pectoral fin. Pores on the snout and chin between projecting folds of skin; suprabranchial pores 2. Pyloric coeca absent from the type, 40 in a small specimen. No prickles.

Anterior dorsal rays buried in pseudotissue. Anal fin similar to the dorsal. Caudal truncate, connected for half its length to the

anal; the dorsal connection less, notched. Pectoral notched; the lower lobe reaching halfway from disk to vent. Disk large, 2.6 in the head; the posterior margin under the gill slit; the flap thick and broad, equal to the center of the disk. Vent close behind disk.

Color grayish purple, probably translucent and pinkish in life, and with the dorsal region marked with large round reddish spots as described; the type is discolored and no spots are visible.

Synopsis.—Dorsal 53; anal 44; pectoral 30–33; caudal 12; pyloric coeca 40. Depth 3.7 in length without caudal; head 4.7? (snout

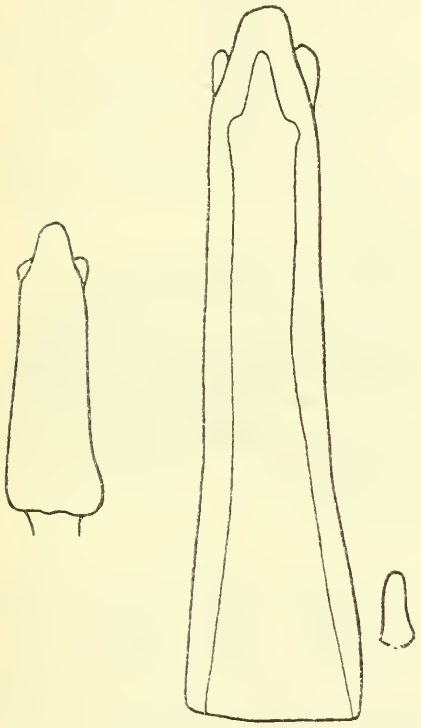

FIGURE 73.—CRYSTALLICHTHYS CYCLOSPILUS. TEETH FROM TYPE

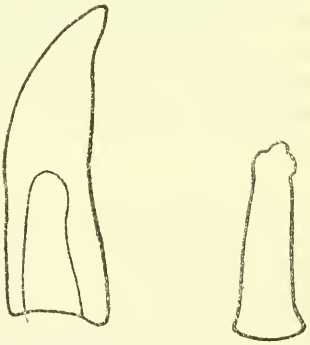

FIGURE 74.—CRYSTALLICHTHYS CYCLOSPILUS. TEETH FROM SPECIMEN 130 MM. IN LENGTH, FROM ALBATROSS STATION 4779, BERING STRAIT

injured). Eye 5–5.5; disk 2.6–3. Body deep, greatly compressed. Head much compressed. Snout conical, projecting, the lower surface cleft longitudinally. Teeth blunt, distinctly trilobed. Gill slit above the pectoral fin. Pupil as in *C. cyclospilus*. Disk normal, large. Suprabranchial pores 1 or 2. Color grayish or whitish, translucent pinkish in life, pinkish blotches on head, body, and fins, these not so rounded as in *C. cyclospilus*, some irregular, other barlike.

Remarks.—Note on a small specimen from *Albatross* Station 4794. Head 3.5; depth 3.7. Dorsal 53; anal 44; pectoral 30; pyloric

coeca 40. Eye 5.5; snout 2.7; gill opening 7; disk 3. Snout cleft on the lower surface as in the type, projecting beyond the upper lip for a distance nearly equal to eye. Teeth trilobed, arranged in seven oblique rows in the half of each jaw. The pupil resembles that in *C. cyclospilus*, elliptical, horizontal, partially divided from the dorsal

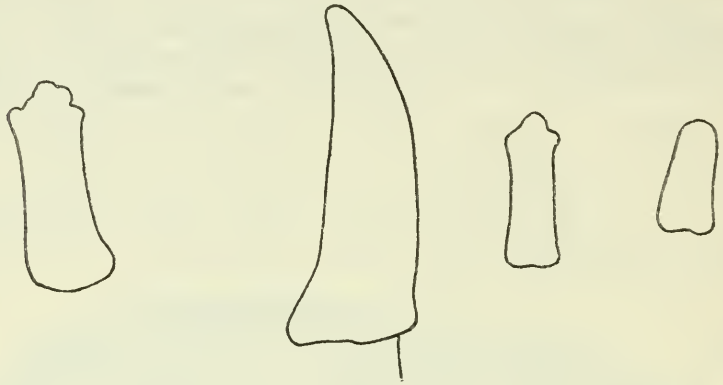

FIGURE 75.—CRYSTALLICHTHYS MIRABILIS. TEETH FROM TYPE

side. Distance from tip of lower jaw to disk 3.3 in the head. Pores 2–5–6–1. Body translucent; body, head, and fins with short, narrow, pale bars and small roundish spots; a bar extending forward from eye and one above eye; the bars and spots, probably, pinkish in life, shaped somewhat as in *Crystallias matsushimae*. No notch between dorsal and caudal; caudal slightly rounded.

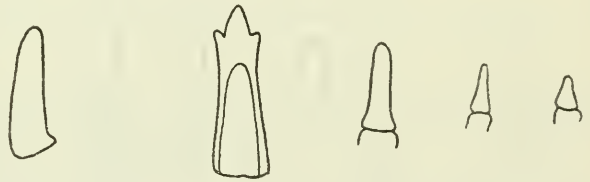

FIGURE 76.—CRYSTALLICHTHYS MIRABILIS. TEETH FROM A YOUNG SPECIMEN FROM ALBATROSS STATION 4797, OFF KAMCHATKA

Genus CRYSTALLIAS Jordan and Snyder

Crystallias JORDAN and SNYDER, 1902, Proc. U. S. Nat. Mus., vol. 24, p. 349.

Disk present; nostril single; teeth trilobed; suprabranchial pore single; pyloric coeca present; pseudobranchiae absent; branchiostegal rays 6; snout with barbels.

Genotype.—Crystallias matsushimae.

CRYSTALLIAS MATSUSHIMAE Jordan and Snyder

Crystallias matsushimae JORDAN and SNYDER, 1902, p. 350, figure 2.—SCHMIDT, 1904*a*, p. 167, pl. 6.—JORDAN, 1905*b*, p. 218, figure 158.—GILBERT and BURKE, 1912*b*, p. 376.

Type.—No. 49802, U.S.N.M.; *Albatross* Station 3773, Matsushimae Bay, Japan; depth 78 fathoms. Length 113+ mm.

Distribution.—Okhotsk Sea, Japan Sea, and Matsushimae Bay, Japan, depth 70–200 fathoms. Eight specimens examined, the largest 221 mm.

Relationships.—*C. matsushimae* resembles *Crystallichthys mirabilis* in the cleft snout, shape of head and body, and the coloration; differing mainly in the presence of barbels and the character of the pupil.

Description of type.—Dorsal 56; anal 53; caudal 10; pectoral 31; pyloric coeca 71 (not from type). Depth 4.7 in length without caudal; head 4.2. Eye 5 in head; disk 3.

Body as in *C. mirabilis*, gelatinous, deep and much compressed; the depth about twice the width; cheeks nearly vertical; profile nearly straight from snout to occiput. Mouth narrow, Teeth short, stout, blunt, strongly trilobed; oblique rows widely spaced,

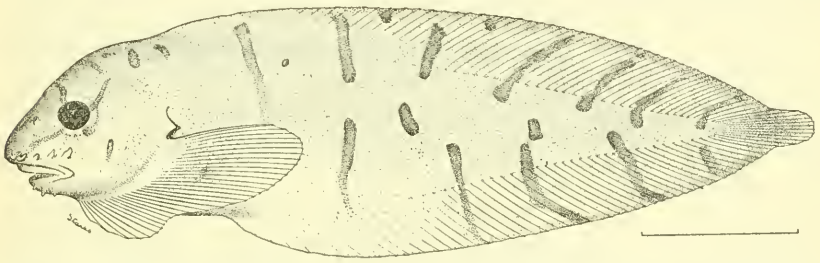

FIGURE 77.—CRYSTALLIAS MATSUSHIMAE. INTRODUCED TO SHOW THE BARBELS DISTINGUISHING THE GENUS. TYPE

about 18 in the half of each jaw. Snout distorted; jaws equal. The following description of the snout and barbels is taken from two specimens from *Albatross* Station 4855, Japan Sea. Snout projecting beyond the upper lip for the diameter of the orbit. Barbels on each side of the snout as follows: One in front of the upper snout pore and at the tip of the snout; sometimes a second lateral to and separated from the former barbel by the anterior pore on the snout; three on the lower anterior surface of the snout between the maxillary pores, separated from those on the other side of the snout by the stiff vertical fold terminating and dividing the lower surface of snout. The upper lip with three and sometimes five short barbels. Lower lip with a median and two lateral barbels on each side, separated by the mandibular pores; sometimes a second series of two behind the first series. The longest barbel on the snout equals the eye; the barbels on the chin equal to half the eye. The upper lip and lower surface of snout divided, a stiff vertical fold of skin projecting from the base of the cleft, as in *Crystallichthys mirabilis*. Nostril in a

prominent tube. Eye moderate; the lower half silvery; pupil elliptical, horizontal, apparently not partially divided as in *Crystallichthys*. In some specimens the eye is black and the pupil distended and round. Gill slit small, above the pectoral fin. Pores 2–5–6–1 on a specimen from *Albatross* Station 4855; rudimentary pores on the sides of the body as in species of *Liparis*. Pyloric coeca 71, in one specimen on the right side of the body cavity, 1.8 in the head.

Anterior dorsal rays buried in pseudotissue beneath the skin. Anal similar to the dorsal. Caudal truncate, connected for a little more than half its length to the anal fin. Pectoral fin notched; the lower lobe more distinct than figured, reaching the vent, 2.4 in the head, composed of thickened rays as in *Liparis*. Disk large; tip of mandible to disk 11.2 in the length of the body without caudal. Vent close to the disk.

Color translucent, pinkish in life; narrow dark bars and spots on the head and body; bars beginning near the median line on the sides and extending onto the dorsal and anal fins, seven above and five below; one bar extending backward from the lip through the eye; two across the top of the head; other spots and bars on head and body smaller; peritoneum and stomach pale.

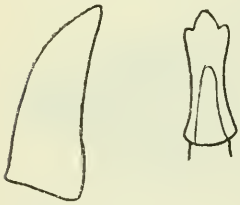

FIGURE 78.—CRYSTALLIAS MATSUSHIMAE. TEETH FROM TYPE

Synopsis.—Dorsal 56; anal 53; pectoral 31; caudal 10; pyloric coeca 71. Depth 3.2–4.7; head 3.9–4.2. Eye 5.5 in head; disk 3. Body deep and much compressed, gelatinous. Teeth blunt, strongly trilobed. Snout distinctly projecting, cleft. Barbels present on chin and snout. Eye moderate; pupil oval. Gill slit above the pectoral fin. Disk large, flat. Body translucent, pinkish; narrow bars and spots on head and body as in *Crystallichthys mirabilis;* peritoneum pale.

Genus GYRINICHTHYS Gilbert

Gyrinichthys GILBERT, 1895, Rept. U. S. Fish. Comm., 1893, p. 444.

Disk present; nostril single; teeth simple; suprabranchial pore single; pyloric coeca present; gill slit reduced to a minute pore above the pectoral fin; branchiostegal rays 6.

Genotype.—Gyrinichthys minytremus.

GYRINICHTHYS MINYTREMUS Gilbert

Gyrinichthis minytremus GILBERT, 1896, p. 444.—JORDAN and EVERMANN, 1898, p. 2137.

Type.—Female, No. 48617, U.S.N.M.; *Albatross* Station 3331, north of Unalaska, Bering Sea; depth 350 fathoms. Length 72 mm.

Distribution.—Bering Sea, *Albatross* Station 3331, depth 350 fathoms.

Relationships.—*G. minytremus* differs from certain species of *Careproctus* solely in the reduced gill slit. See discussion of the relationships of the genera.

Description of type.—Head 5.5 in length without caudal. Eye 3.3 in head; disk 2.2 Pectoral 25; caudal 14.

Body rather slender and elongate as in *Careproctus ectenes;* abdomen distorted with large eggs. Head small, depressed, a little deeper than wide; depth 7, width 8 in length without caudal; cheeks nearly vertical; occiput not swollen; interiorbital flat, internostril 3.2 in the head. Mouth small, terminal, with little lateral cleft; maxillary reaching a vertical from slightly behind the front of the eye. Teeth simple, slender, concial, inner teeth prominent, much larger than outer teeth; about five widely spaced oblique rows in the half of each jaw. Snout short, 3 in the head, rising abruptly from the mouth. Nostril single, the tube with a raised rim in front. Eye large, black; pupil round. Gill slit a minute pore that will not admit a large dissecting needle, high up above the base of pectoral fin. Tip of

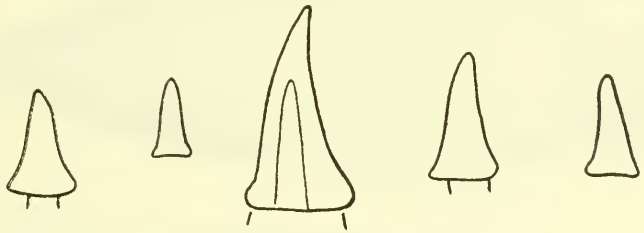

FIGURE 79.—GYRINICHTHYS MINYTREMUS. TEETH FROM TYPE

opercular arm buried beneath skin. One suprabranchial pore present, above and behind the gill slit; upper pores on the snout high; nearly between the nostrils. Pyloric coeca unknown. No prickles.

Origin of dorsal fin back of the middle of the pectoral; the anterior rays not distinctly seen but not buried in thick tissue. Caudal truncate, of very slender rays, connected for half its length to the anal, the dorsal and anal connections with the caudal gradual. Pectoral fin not notched, with the upper edge on a level with the lower margin of the orbit, of about 25 rays which increase gradually in length. Disk well formed, oval; snout to disk 8.5 in the length without caudal. Vent close to the disk; tip of mandible to vent 4.3 in length without caudal.

Color light brown; peritoneum white, dotted with brown.

Synopsis.—Pectoral 25; caudal 14. Body rather slender and elongate; head 5.5 in length without caudal. Eye 3.3 in head; disk 2.2. Teeth simple, slender and conical. Eye large, black; pupil round. Gill slit reduced to a minute pore high up above the base of the pectoral fin. One suprabranchial pore evident. Pectoral fin apparently

unnotched; the rays increasing gradually in length. Body slightly brownish; peritoneum pale.

Genus ELASSODISCUS Gilbert and Burke

Elassodiscus GILBERT and BURKE, 1912*a*, p. 81.

Disk not perfect, reduced to a rudiment, the rays absent; nostril single; teeth trilobed; suprabranchial pore single; pyloric coeca present; pseudobranchiae absent; branchiostegal rays 6.

Genotype.—Elassodiscus tremebundus.

ELASSODISCUS TREMEBUNDUS Gilbert and Burke

Elassodiscus tremebundus GILBERT and BURKE, 1912*a*, p. 81.

Type.—No. 74388, U.S.N.M.; *Albatross* Station 4797, off Starits-chkof Island, Kamchatka; depth 682 fathoms. Length 214 mm.

Distribution.—Southeast coast of Kamchatka; *Albatross* Station 4797; depth 682 fathoms. Numerous specimens examined.

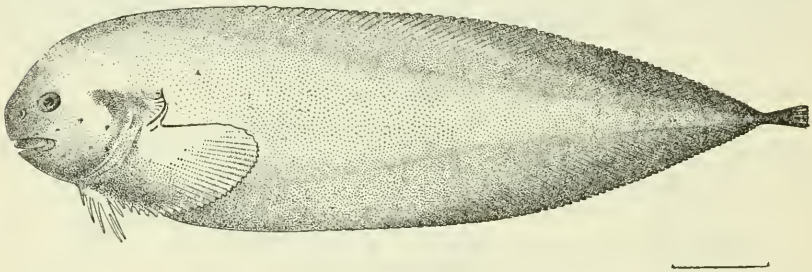

FIGURE 80.—ELASSODISCUS TREMEBUNDUS. TYPE

Synopsis.—Dorsal 65; anal 60; pectoral 32; caudal 8; pyloric coeca 16. Depth 4.4 in length without caudal; head 3.6. Eye 5.5 in head. Body moderately elongate, deep and much compressed. Teeth stout, trilobed. Gill slit above the pectoral fin. One suprabranchial pore present. Disk rudimentary. Body pale; lips and gill cavity dusky; caudal and the marginal half of the dorsal and anal posteriorly black; peritoneum and stomach black. In life translucent, reddish. Specimens numerous, reaching a length of 214 mm. or more.

Genus PARALIPARIS Collett

Paraliparis COLLETT, 1878, Chra. Vid. Selsk. Forh., 1878, No. 14, p. 32, (*bathybii*).

Amitra GOODE, 1880, Proc. U. S. Nat. Mus., vol. 3, (*liparina*).

Monomitra GOODE, 1883, Proc. U. S. Nat. Mus., (*liparina*)?.

Hilgendorfia GOODE and BEAN, 1895, Special Bull. U. S. Nat. Mus., No. 2., (*membranaceus*).

Amitrichthys JORDAN and EVERMANN, 1896, Rep. U. S. Fish Comm., 1895, p. 453, (*cephalus*).

Hilgendorfia JORDAN and EVERMANN, 1896, Rep. U. S. Fish Comm., 1895, p. 453; 1898, Bull. U. S. Nat. Mus., No., 47, (*ulochir*).

Disk absent; nostril single; teeth trilobed to simple; suprabranchial pores apparently single in all the species; pyloric coeca present, in small numbers; pseudobranchiae absent;[14] branchiostegals 6.

MODIFICATION OF CHARACTERS

Body.—In the species of *Paraliparis* the body is never depressed as in the species of *Liparis*. It is compressed but never attains the depth of some of the species of *Careproctus*. The shape of the body varies among the different species. In *P. copei* it is moderately stout and elongate, in *P. holomelas* very heavy anteriorly and attenuate posteriorly and in *P. mento* very slender. Many of the species have the posterior part of the body attenuate, the vertebrae being very small and evident through the skin.

The bodies of the species of *Paraliparis* are typically frail and soft but lack the excessive amount of pseudotissue found in many species

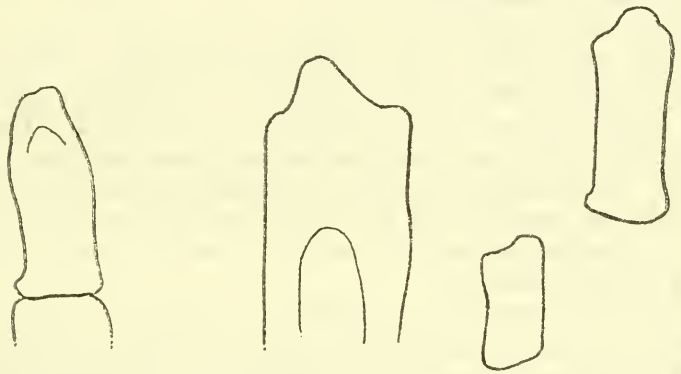

FIGURE 81.—ELASSODISCUS TREMEBUNDUS. TEETH FROM COTYPE

of *Careproctus*. *Paraliparis* is more typically a deep-sea genus than *Careproctus*. Pseudotissue apparently is more common to the shallower water species of the two genera.

The shape of the body and the proportional measurements of head and body have been used in but a general way in distinguishing the species.

Head.—The head furnishes a number of useful characters. It is typically compressed. The width of the head is seldom if ever equal to the depth. The snout is usually deep and abrupt. It distinguishes a few of the species by projecting slightly. The profile of the head is typically rather low and rises gradually to the nape. *P. cephalus* is distinguished by the occiput being greatly swollen. The mouth is usually horizontal, but *P. cephalus* and a few other species are distinguished by the mouth being at an angle. When the mouth is on an angle the lower jaw may be heavy and project as in *P. mento*.

[14] See discussion of this character.

Nostril.—The posterior nostril is absent in this genus. The anterior nostril opens close in front of the eye. There is never a prominent tube. In a number of species the tube appears to open to the surface by a pore. So far as known the nostril does not present any characters of specific value. The skin in many of the species was in such a condition that the nostril could not be adequately studied.

Eye.—The characters presented by the eye have been utilized but to a slight extent. This is due to the lack of good material. The eyes of many of the specimens examined were in poor condition and would not admit of any importance being placed upon the differences they presented. The size of the eye among the different species varies from 2.8 to 5.4 in the length of the head. The pupil is always round or slightly oval and usually large. The color of the eye varies from black to silvery. The silvery pigment is likely to disappear in preserved specimens.

Pores.—The pore formula for many of the species could not be made out on account of the condition of the skin. The formula appears to vary from 2–6–7–1 to 2–5–6–1. In none of the species could more than one suprabranchial pore be detected. The upper pores on the snout are close together and practically between the nostrils. Rudimentary pores were not observed in any of the species. The pores are usually small but may be enlarged as in *P. holomelas.* In a few species the anterior mandibular pores are united, that is, have a common opening.

Gill slit.—The size of the gill slit in a number of the species is unknown because of the torn condition of the skin. The gill slit has about the same amount of modification as in *Careproctus.* In the majority of the species it is confined to the region above the base of the pectoral fin. In but a few of the species does the slit extend down in front of the pectoral. The largest gill slit is found in *P. holomelas* in which species it extends down in front of 13 pectoral rays.

Teeth.—The teeth in *Paraliparis* show a greater range of modification than in any other genus of the family. In *P. dactylosus* the teeth are trilobed. In the majority of the species they are simple, conical, and in narrow or broad bands; the oblique rows few or many, obscure or prominent; the inner teeth enlarged or not. In *P. atramentatus* the teeth are very stout and apparently suited for crushing hard objects. In *P. rosaceus* they are stout, wedge-shaped, arranged in a single series, and their tips form a sharp cutting edge. The teeth of the species of this genus deserve special study for they are of considerably taxonomic importance. The different types of dentition described appear to grade into each other and can not be

of generic value. They are, however, of great value in distinguishing species or groups of species.

I have not attempted to utilize to any great extent the modifications in shape, size of pulp cavity, and numbers in the teeth of these species. When the time comes for a more intensive study of the fishes, the teeth will probably be found to offer a profitable line of research. The data that we have at present is not satisfactory for the reasons that we do not know the amount of variation in the teeth of the young and adults and between the two jaws and different sections of each jaw.

Dorsal fin.—The dorsal fin in this genus has not been studied sufficiently to warrant the use of the number of rays in distinguishing species. The number of dorsal rays varies from 48 to 66 or more. We have made no attempt to study the amount of specific variation. The rays are extremely delicate and difficult to count accurately. For these reasons the writer has made no attempt to use the number of dorsal and anal rays in separating species. Dorsal fin is unnotched.

The segmentation of the anterior dorsal rays was investigated in a number of species. The anterior rays are divided but unsegmented. The number of unsegmented rays varies among the different species. The species examined, with the number of unsegmented dorsal and anal rays, are listed below:

	Dorsal fin	Anal fin
copei	18	16
Do	(?)	8
Do	13	10
deani	9	4
Do	11	4
cephalus	10	6

Anal fin.—What has been said concerning the number of dorsal rays applies equally well to the number of anal rays. The number of anal rays varies from 42 to 60.

Caudal fin.—In studying the caudal fin attention should be directed to the number of rays and the connection with the dorsal and anal fins. The number of rays varies from three or four to eight. Apparently there is little variation in the number for each species. This is a question which needs further study. Apparently there are no rudimentary rays at the base of the caudal as in *Liparis*.

The caudal fin is always distinct. The dorsal and anal are never continuous as frequently described. The connection between the anal and the caudal varies from 0.3 to 0.6 of the length of the latter. The connection with the dorsal and anal is usually very gradual, though somewhat abrupt in a few species.

Pectoral fin.—The pectoral fin presents some of the most important specific characters. These have been used freely in the key to the

species. The number of rays, the extent of the pectoral notch and development of the middle pectoral rays, the length of the lower pectoral lobe, and the level at which the upper edge of the pectoral is attached to the body have been found to be of the most importance.

The pectoral notch is distinct in all the species except *P. fimbriatus*, in which it is hardly evident. *P. fimbriatus* is distinguished also by the pectoral rays being evenly spaced on the girdle. The middle pectoral rays are, in all the other deep-sea species of the family, more widely spaced than the rays above or below. In species like *P. holomelas* and *P. bathybius* in which the pectoral notch extends to or nearly to the girdle the middle rays are reduced to short filaments and may not project into the fin membrane. In none of the species examined by the writer, with the possible exception of *P. rosaceus*, in which one ray appears to have been torn away, is the middle of the girdle bare of rays for an unusual distance. The distance between the rudimentary rays may progressively increase toward the lower lobe. The space between the lowest rudimentary ray and the upper ray of the lower lobe was never found to greatly exceed the space between the two lower rudimentary rays. Günther describes *P. bathybius* and Gilchrist *P. australis* as having the girdle opposite the notch free of rays.

The length of the lower pectoral lobe varies considerably. In *P. melanobranchus* the lower lobe is contained twice in the head and in *P. mento* it is longer than the head. The variation of the length of the lobe within the species can not be studied because of the lack of material.

The lower pectoral lobe never consists of graduated rays as in *Careproctus* and *Liparis*. In some of the species the lower ray is not more than one-half the length of the next ray but there is never a series of rays beginning with a short one and increasing regularly in length.

The rays of the lower pectoral lobe are usually half free. In some species, as in *P. holomelas*, they are free practically to the base. They are frequently coiled or wavy at the tips.

The level on the side of the body at which the upper part of the pectoral fin is fastened is considerably lower in some of the species than in others. In the more generalized species the upper edge of the pectoral is on a level with the pupil. In *P. cephalus* it is below the level of the orbit and in *P. mento* below the angle of the mouth. In these species the pectoral girdle becomes more oblique and the symphyses of the pectoral is carried forward onto the throat until, as in *P. mento*, it is in front of a vertical from the anterior border of the eye. Associated with the lowering of the pectoral is the projection and enlargement of the lower jaw and the changing of the angle of the mouth.

Günther describes *P. membranaceous* as having a very delicate fringed pectoral. This species has not been examined by the writer.

Vent.—The position of the vent varies from beneath the gill slit to beneath the eye. The distance between the tip of the lower jaw and the vent varies with the position of the vent and has been used to some extent in separating species.

Pseudobranchiae.—The writer has been aunble to demonstrate the presence of pseudobranchiae in any of the specimens examined. These specimens were in such condition that it can not be said that psuedobranchiae were not present. Goode has described pseudobranchiae in *P. liparina* but I have been unable to confirm his description.

Pyloric coeca.—The number of pyloric coeca has been greatly reduced in this genus and varies from 5 to 18. As in *Careproctus* the coeca are on the left side. At present we can not estimate their taxonomic importance.

Prickles.—Thumb-tack prickles have been discovered on only one species, *P. deani.* None of the species are known to have cactuslike prickles.

Coloration.—The range of coloration exhibited by the species of *Paraliparis* is similar to that of the species of *Careproctus.* The color of the species varies from white or pinkish to black. *Paraliparis* in distribution, structure, and coloration is more of a deep-sea genus than *Careproctus.* More of the species, fully 50 per cent, are black and the peritoneum is dusky or black in nearly all the species. (See *deani* and *entochloris.*) The stomach, gill cavity, and mouth are frequently dusky or black.

As in *Careproctus* the pigment is more common to the deeper water forms. None of the black species have been taken at a depth of less than 405 fathoms. *P. rosaceus,* a light colored species, is found at a depth of 984 fathoms but the majority of such species are restricted to shallower water. When the body is partly black the pigment is usually confined to the posterior region. An exception is found in *P. rosaceus,* in which the pigment is most pronounced on the snout.

The variations in the coloration of the skin, flesh, peritoneum, stomach, gill cavity, and mouth all deserve careful consideration for they frequently indicate specific differentiation.

Habits.—The habits of the species of *Paraliparis* are probably similar to those of the species of *Careproctus.* Species have been taken from all kinds of mud and rock bottom.

Little is known concerning the food habits of these fishes. The lack of material prevented an examination of the contents of the stomachs. The teeth are greatly modified in some of the species and probably indicate special food habits.

Summary.—In order to present a guide to the study of the specific characters of these fishes the following outlines are given. The first list suggests the characters which the writer has found to be the most valuable in separating and detecting species. The second list involves those characters which could not be adequately studied but which give promise of being of taxonomic importance and warrant further study. For modification of characters in the genus see table on page 36.

List 1

Body	Depth.
	Length.
Head	Depth, snout.
	Depth, occiput.
	Angle of mouth.
Eye	Size.
Gill slit in relation to pectoral.	
Teeth	Trilobed.
	Shape.
	Size.
	Bands.
	Single series.
Pectoral	Number of rays.
	Level of upper edge.
	Rudimentary rays.
	Depth of notch.
	Length of lower lobe.
	Spacing of rays.
	Separation of rays of lower lobe.
Coloration	Body.
	Peritoneum.
	Stomach.
	Gill cavity.
	Mouth.
Distribution.	

List 2

Head	Nostril.
Eye	Pupil.
	Color.
Pores	Formula.
	Position.
	Size.
	United on chin.
Dorsal	Number of rays.
	Buried in tissue.
	Spinelike rays.
Anal	Number of rays.
Caudal	Number of rays.
	Shape.
	Connection with dorsal and anal.
Coeca	Number.
Prickles.	

DISTRIBUTION

The genus *Paraliparis* is represented throughout the regions occupied by *Careproctus*, that is, the cold northern and southern regions of the Atlantic and Pacific and the depths of the tropical Pacific. The limits of the bathymetrical distribution of the two genera are practically identical. *Paraliparis* has been taken in depths ranging from 30 to 1793 fathoms. The distribution of the two genera differ in two particulars. A smaller percentage of the species of *Paraliparis* have been taken in the North Pacific and a larger percentage in the tropical Pacific. Also the genus typically inhabits greater depths than does *Careproctus*. About half of the species are found above and half below the 500 fathom level. The 300-fathom level holds the same relation to the distribution of the species of *Careproctus*.

Paraliparis, in distribution as well as in structure, is more typically a deep-sea genus than *Careproctus*.

The giant species of the genus are not confined to the North Pacific. These species are: *P grandiceps*, 256 mm., Gulf of California, 1,588 fathoms; *P. bathybius*, 208 mm., Arctic Ocean, 640–658 fathoms; *P copei*, 178 mm., off New England, 300–594 fathoms; *P latifrons*, 147 mm., off Panama, 1,793 fathoms; *P rosaceous*, 135+ mm., off California, 984 fathoms.

The maximum temperature record for any of the species is that of 52.8° F. for *P. cephalus*. The minimum temperature is that of 28° F. for *P. bathybius*. The majority of the species are taken in temperatures ranging from 35° to 45° F. and live in an average temperature of 40° F. The greatest range of temperature recorded for any species is 15° F. for *P. cephalus*.

Regions.—We know so little about the species of *Paraliparis* that we can only state the facts that we have without drawing any conclusions as to the regions or the center of dispersal. The majority of the species are known from but a single dredge haul. None of the species are common to both the Atlantic and Pacific or to the Japanese and American coasts. The Aleutian Islands do not act as a barrier to these fish.

We have yet to discover the extent of the range of these deep-sea fish. We have practically nothing to indicate whether or not they are cosmopolitan in their distribution. *P. ulochir* is recorded from the Gulf of California and Bering Sea. None of the other species are recorded from such widely separated localities.

Bathymetrical distribution.—Species of *Paraliparis* have been taken in depths ranging from 30 fathoms off British Columbia to 1,793 fathoms off Panama. About half of the species have been taken above and half below the 500-fathom level. The vertical distribution of some of the species appears to be excessive though we should be careful in accepting the records as accurate when the dredge is hauled up open. *P. holomelas* appears to have a vertical range of 1,219 fathoms and *P. ulochir* of 599 fathoms. These may be extended or restricted when the species become better known. While some of the species have considerable vertical range none of them extend from the well lighted regions down below the penetration of sunlight. The species may extend from the well lighted to the dimly lighted regions or from the dimly lighted regions to the dark regions. None of the species of the family are known to exist on both sides of the region between 250 and 500 fathoms which may be considered as the dimly lighted regions of the oceanic depths.

KEY TO SPECIES OF PARALIPARIS[15]

A[1]. Teeth trilobed; gill slit in front of 4 pectoral rays; coeca 13–18; pectoral rays 30 or more ..... dactylosus.

A[2]. Teeth simple.

B[1]. Pectoral with more than 30 rays; pectoral notch very shallow ..... angustifrons.

B[2]. Pectoral with less than 30 rays.

C[1]. Teeth in bands.

D[1]. Teeth conical.

E[1]. Mouth horizontal.

F[1]. Middle pectoral rays not rudimentary, distinctly forming part of the fin outline; pores on the head not enlarged.

G[1]. Pectoral normal.

H[1]. Pectoral rays evenly spaced on the girdle; little shorter than lower rays ..... fimbriatus.

H[2]. Middle pectoral rays widely spaced.

J[1]. Gill slit extending down in front of the pectoral?

K[1]. Pacific; dorsal 56; anal 46; gill slit in front of 10 pectoral rays ..... deani.

K[2]. Pacific; dorsal 63; anal 56; gill slit? ..... entochloris.

K[3]. Atlantic; dorsal 59; anal 51; pectoral 20; gill slit probably above the pectoral ..... bathybius[16].

J[2]. Gill slit above the pectoral fin.

L[1]. Atlantic.

M[1]. Color pale ..... liparina.

M[2]. Color black ..... bathybius.

L[2]. Pacific.

N[1]. Pectoral 25; the upper edge on a level with the upper margin of the eye; color black, including mouth and gill cavity ..... ulochir.

N[2]. Pectoral 20; the upper edge on a level with the pupil; color pale, including mouth and gill cavity; gill slit unknown ..... entochloris.

N[3]. Pectoral 17; the upper edge on a level with the pupil; color pale; mouth and gill cavity black ..... melanobranchus.[16]

G[2]. Pectoral delicate, fringed ..... membranaceous.[16]

F[2]. Middle pectoral rays rudimentary, short or absent.

O[1]. Color black; rudimentary median pectoral rays present; rays 23.

P[1]. Stomach pale ..... latifrons.

P[2]. Stomach black ..... holomelas.

O[2]. Color black; pectoral rays 15–19?; no rudimentary rays? ..... bathybius.[16]

O[3]. Color pale; pectoral 17; no rudimentary rays between the two lobes ..... australis.

E[2]. Mouth at an angle.

Q[1]. Atlantic; depth 4.6; snout to vent 6; pectoral 21; the upper edge of the fin above the angle of the mouth; the middle rays rudimentary; the symphysis behind the front of the eye; stomach pale; caudal 8 ..... garmani.

[15] See appendix for additional species.

[16] In key in more than one place.

Q². Pacific; snout to vent 5.5; pectoral 14; the upper edge of the fin above the angle of the mouth; the middle rays not rudimentary; the symphysis behind the front of the eye. **cephalus.**

Q³. Pacific; depth 6; snout to vent 9.8; pectoral 16; the upper edge below the angle of the mouth; the middle rays not rudimentary; the symphysis in front of the eye. **mento.**

D². Teeth blunt, not conical. **atramentatus.**

C². Teeth in a single series.

R¹. Atlantic; snout to vent 8.5; head 6.5 **copei.**

R². Pacific.

S¹. Snout to vent 6; head 5; color rose red; fins and snout largely black; dorsal 58; anal 53; pectoral 20. **rosaceus.**

S². Color blackish; dorsal ca 56; anal ca 42; pectoral 24; gill slit unknown. **grandiceps.**

S³. Color blackish; dorsal 66; anal 57; pectoral 24; gill slit unknown. **attenuatus.**

SUPPLEMENTARY KEY TO SPECIES OF PARALIPARIS

A¹. Atlantic species.

B¹. Teeth in bands.

C¹. Color pale.

D¹. Mouth horizontal.

E¹. Pectoral normal.

F¹. Caudal 9; D. 48; P. 17; no rays between the two pectoral lobes. **australis.**[16]

F². Caudal 4; D. 58; P. 22; 3 rudimentary rays between the two lobes of the pectoral. **liparina.**

E². Pectoral delicate, fringed. **membranaceous.**[16]

D². Mouth at an angle. **garmani.**

C². Color blackish. **bathybius.**[16]

B². Teeth in a single series. **copei.**

A². Pacific species.

G¹. Pectoral 30 or more.

H¹. Teeth trilobed; mouth horizontal. **dactylosus.**

H². Teeth simple; mouth oblique; pectoral notch very shallow. **angustifrons.**

G². Pectoral 25 or less.

J¹. Teeth in bands.

K¹. Mouth horizontal.

L¹. Middle pectoral rays long; pores not enlarged.

M¹. Middle pectoral rays evenly spaced on the girdle; little pectoral notch. **fimbriatus.**

M². Middle pectoral rays more widely spaced than those above and below.

[16] In key in more than one place.

N¹. Color pale; skin transparent.
O¹. Mouth and gill cavity pale; peritoneum dotted.
P¹. D. 56; A. 46; gill slit in front of 10 pectoral rays; southeast coast of Alaska----deani.
P². D. 63; A 56; gill slit?; Okhotsk Sea--entochloris.
O². Mouth and gill cavity black; peritoneum black. melanobranchus.
N². Color black.
Q¹. Teeth conical, sharp----------ulochir.
Q². Teeth stout, blunt---------atramentatus.
L². Middle pectoral rays rudimentary; pores on the head enlarged.
R¹. Stomach pale; gill slit?--------latifrons.
R². Stomach black; gill slit extending down in front of 13 pectoral rays---holomelas.
K². Mouth at an angle.
S¹. Symphysis of pectorals behind front of eye----------cephalus.
S². Symphysis of pectoral in front of eye. mento.
J². Teeth in a single row, stout.
T¹. Color rose red, fins and snout largely black----------rosaceus.
T². Color blackish.
U¹. Gulf of California----grandiceps.
U². Off Panama---------attenuatus.

PARALIPARIS DACTYLOSUS Gilbert

Paraliparis dactylosus Gilbert, 1896, p. 469, pl. 34.—Gilbert and Burke, 1912*a*, p. 82.

Type.—No. 48616, U.S.N.M.; *Albatross* Station 3112, off California; depth 296 fathoms. Length about 90 mm.

Distribution.—Coast of California and among the Aleutian Islands, *Albatross* Stations 3112 and 4781; depth 296–482 fathoms. The specimen from Station 4781, Bering Sea, is doubtfully placed with this species. Four specimens examined.

Relationships.—*P. dactylosus* differs from all the other species of the genus in the trilobed teeth. In the character of the teeth, number of pectoral rays, and pyloric coeca, this species is the most generalized of the genus.

Description of type (*mutilated*).—Body deepest at the nape; the dorsal outline descending very rapidly for a short distance, then gradually to the attenuate tail. Head moderate; cheeks nearly vertical; profile gradual from occiput to snout, then vertical to the lips. Mouth narrow, the angle reaching under front of pupil. Teeth short, stout, blunt, weakly trilobed, in moderate bands, arranged in eight oblique rows. Snout deep, abrupt. No nostril tube evident. Eye large, 3.3 in head; black; pupil large, oval. Gill slit described as extending down in front of three or four pectoral rays. Pores? Pyloric coeca 13, equal to the eye.

Dorsal of very slender rays. Caudal absent. Pectoral deeply notched; the two lobes connected by short, delicate rays; the upper edge of the pectoral on a level with the lower margin of the eye; the lower lobe mutilated, of about six delicate, elongate rays. Vent far forward; tip of mandible to vent 1.5 in the head.

Color of flesh pale, black dotted; mouth, gill cavity and peritoneum black; stomach pale.

Synopsis.—Dorsal 64; anal 59; pectoral 33; pyloric coeca 13–18. Depth 5.7 in the length without the caudal; head 4.8. Eye 3.7 in the head; gill slit 4; lower lobe of the pectoral fin 1.5. Body elongate, attenuate posteriorly. Teeth stout, weakly trilobed. Gill slit extending down in front of four pectoral rays. Pectoral fin deeply notched, not divided to the base. Body pale, probably pinkish in

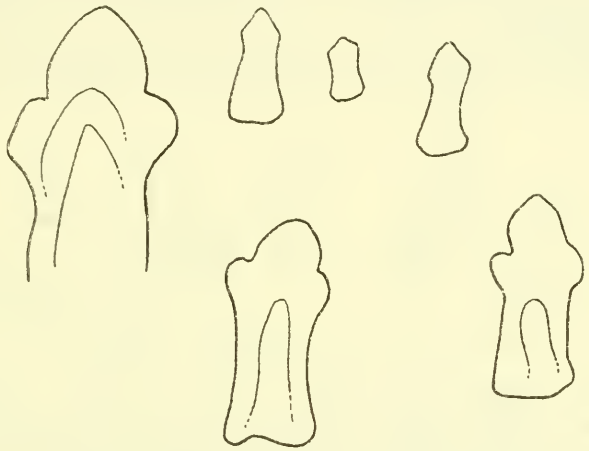

FIGURE 82.—PARALIPARIS DACTYLOSUS. TEETH FROM TYPE

life; mouth, gill cavity, peritoneum, and the vertical fins posteriorly black. Four specimens, reaching the length of 93 mm. or more.

Remarks.—The specimen from Bering Sea, the characteristics of which are given below, apparently differs in no essential respect from the type, though a close comparison between the two specimens has not been made.

Note on a specimen from Station 4781, Bering Sea. Dorsal 64; anal 59; caudal 6; pectoral 34; pyloric coeca 18, one-half the eye. Depth 5.7 in length without caudal; head 4.8. Eye 3.7 in head; lower lobe of pectoral 1.5; caudal 2.7; gill slit 4; tip of mandible to vent 2.7.

Teeth weakly trilobed, in narrow bands; eight oblique rows in the half of each jaw. Gill slit extending down in front of four pectoral rays. Upper edge of pectoral on a level with lower margin of orbit; the

lower lobe of six exserted rays, 1.5 in the head; seven widely spaced, well-developed rays connecting the two lobes. Caudal connected for nearly one-third its length to the anal fin; the dorsal and anal connections with the caudal more or less abrupt.

In life red, the vertical fins posteriorly black.

PARALIPARIS ANGUSTIFRONS Garman

Paraliparis angustifrons Garman, 1899, p. 119, pl. 27, fig. 4; pl. 28, fig. 4; pl. 29, fig. 3.

Types.—Two; No. 28699, M. C. Z.; *Albatross* Station 3394, off Panama, Pacific Ocean; depth 511 fathoms. Length 108 mm.

Distribution.—Known only from the type locality. Two specimens examined.

Relationships.—Differing from *P. dactylosus* in the simple teeth and oblique mouth and from all the other species in the large number of pectoral rays.

Description of the types.—Body as in *P. mento*; deepest at the nape, sloping down for a short distance and then retaining an even depth

Figure 83.—Paraliparis angustifrons. Teeth from type

to near the middle of the body, much compressed. Head much compressed; occiput slightly swollen; profile convex; cheeks vertical. Mouth not greatly enlarged, pointing obliquely upward, the angle reaching beneath the eye; the maxillary reaching beneath the posterior margin of the eye; teeth simple but with shoulder present, short, rather slender, conical, slightly recurved, in narrow bands arranged in oblique rows. Snout low, not projecting; lower jaw heavy; pointing obliquely upward; jaws equal or the symphysis of the lower jaw projecting. Nostril without a tube. Eye moderate, 4 in the head, black; pupil round. Gill slit uncertain. Pores not enlarged; upper pore on the snout nearly on a level with the nostrils. No prickles. Pyloric coeca 6.

Upper edge of the pectoral on a level with the angle of the mouth; the symphisis under the front of the eye; pectoral not divided to the base, apparently with a very shallow notch as described; the lower rays elongate. Caudal connected for at least one-half its length to the anal.

Color dusky, darker along the base of the fins; mouth and peritoneum black; stomach pale.

Synopsis.—From the original description: D. 57; A. 53; P. 37. Depth 5.5 in the total length; head 6.5. Eye 3.3 in the head. Pectoral broad, without a gap at the bases of the rays, but with a notch in the lower half caused by shorter rays; ends of the rays prolonged as filaments. Head and abdomen black; fins blackish; body over the muscular portions somewhat grayish. Total length 4.5 inches. Two specimens.

PARALIPARIS FIMBRIATUS Garman

Paraliparis fimbriatus Garman, 1892, Mem. Mus. Comp. Zoöl., vol. 14, No. 2, p. 9.—1899, Mem. Mus. Comp. Zool., vol. 24, p. 116, pl. 29, fig. 1; pl. D. fig. 3.

Type.—No. 28702, M. C. Z.; *Albatross* Station 3381, off Panama, Pacific Ocean; depth 1,772 fathoms. Length 4 inches.

Distribution.—Known only from the type locality.

Relationships.—*P. fimbriatus* does not appear to be closely related to any known species. It appears to be distinct from all the species

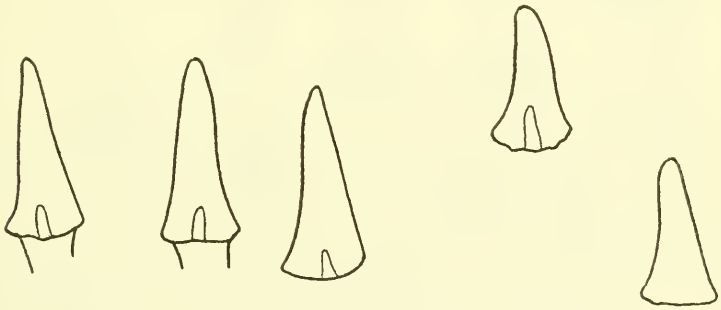

Figure 84.—Paraliparis fimbriatus. Teeth from type

with the exception of *P. angustifrons*, in having the middle pectoral rays no more widely spaced than those above and below. It is distinguished from *P. angustifrons* by the smaller number of pectoral rays, the angle of the mouth and in other characters.

Description of type.—The type is so badly mutilated as to be valueless; what remains appears to agree with the original description and the figure. The following notes were taken.

Body slender; the dorsal outline not descending rapidly. Head low, broad, the width equal to the depth; profile low, convex; occiput not swollen. Mouth wide; maxillary reaching beneath the posterior margin of the orbit. Snout low, retreating, slightly projecting; the lower jaw included. Teeth slender, conical, simple, not recurved, in very narrow bands, apparently in a few oblique rows; the pulp cavity small. Condition of the nostril, gill slit, pores, and pyloric coeca uncertain. No prickles.

Pectoral slightly notched; the lower lobe hardly distinguishable; all of the rays evenly spaced on the girdle, elongate, filamentous at

the tip. Head and body anteriorly blackish, paler posteriorly; peritoneum black.

Original description abbreviated; D. 49; A. 45; P. 24. Depth 7 in the total length; head 5.5. Eye 4 in the head. Head flattened on the crown; nape not high. Snout short, nearly as long as the eye. Pectoral broad, notched somewhat by the shorter fifth and sixth ray, each ray prolonged into a soft filament. Length 4 inches.

PARALIPARIS DEANI Burke

Paraliparis holomelas Evermann and Goldsborough, 1907, p. 334, (part, not of Gilbert).

Paraliparis deani Burke, 1912*a*, p. 571.—Gilbert, 1915, p. 355.

Type.—No. 60570, U.S.N.M.; Stephens Passage, southeast coast of Alaska, *Albatross* Station 4253; depth 188 fathoms. Length 68 mm.

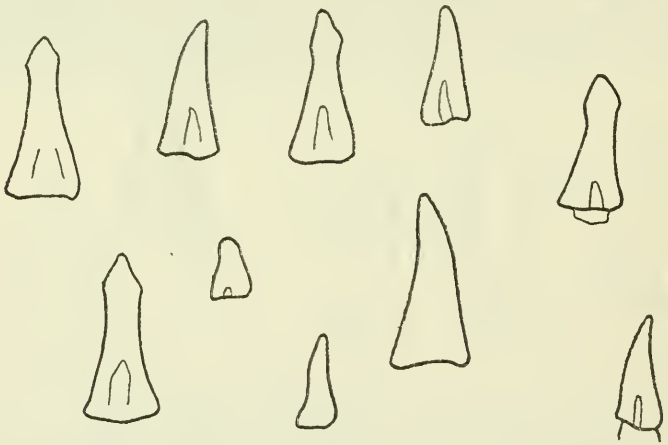

Figure 85.—Paraliparis deani. Teeth from type

Distribution.—Southeast coast of Alaska; *Albatross* Stations 4194, 4203, 4251, 4253, 4255, 4292, and 4293; depth 30–274 fathoms. Twenty-two specimens examined.

Relationships.—*P. deani* is one of the few species of the genus in which the gill slit extends down in front of the pectoral fin. It is possibly allied to *P. entochloris* of the Okhotsk Sea, apparently differing in the smaller number of dorsal and anal rays and possibly in the stronger dentition and the presence of prickles.

Synopsis.—Dorsal 56–57; anal 44–48; pectoral 18–21; pyloric coeca 9. Depth of body 4.5–6 in length without caudal. Lower lobe of pectoral 1.2 in head. Gill slit extending down in front of 10 to 13 pectoral rays. Teeth simple but with a well developed shoulder near the tip, somewhat arrow-shaped at the tip, short, slender, slightly recurved. Thumb-tack prickles present. Body pale; peritoneum

silvery; stomach black. A small sized species, reaching a length of less than 100 mm.

Remarks.—The remaining specimens examined vary somewhat from the type. The gill slit extends down in front of from 10 to 13 pectoral rays. The eye varies from silvery to black. The absence of silvery pigment in the eye may be due to the preserving fluid. In the two cotypes, as in the type, the lower lobe of the pectoral fin

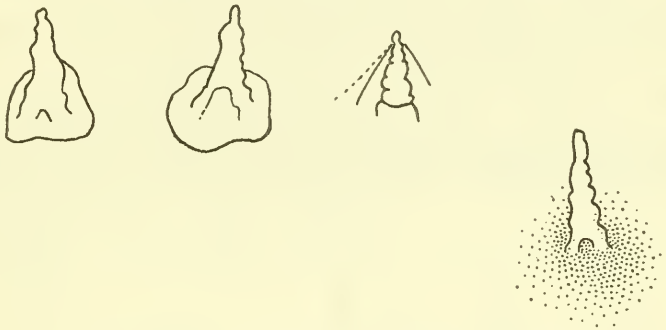

FIGURE 86.—PARALIPARIS DEANI. PRICKLES FROM TYPE

retains the epidermis in which are found thumb-tack prickles. None of the specimens have prickles scattered over the body. As the epidermis is absent from the bodies of all the specimens, prickles may have been present on the sides of the body in life. The caudal fin is either truncate of slightly concave. Specimens No. 60671 differ from the other specimens and may represent another species. They are larger with shorter, deeper bodies and a paler coloration.

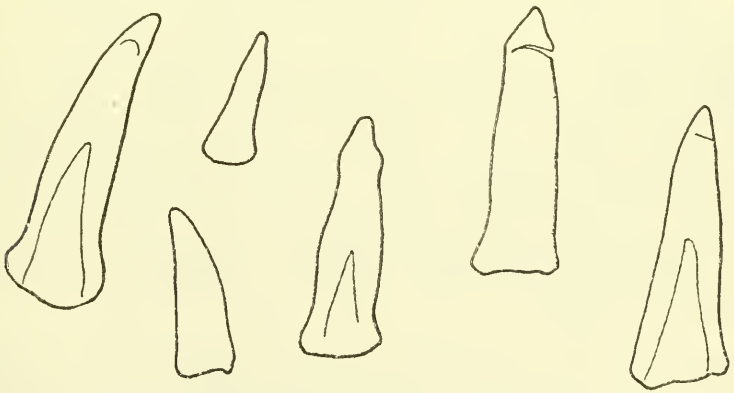

FIGURE 87.—PARALIPARIS ENTOCHLORIS. TEETH FROM TYPE

PARALIPARIS ENTOCHLORIS Gilbert and Burke

Paraliparis entochloris GILBERT and BURKE, 1912*b*, p. 378.

Type.—No. 73347, U.S.N.M.; *Albatross* Station 5018, Okhotsk Sea, off the coast of Saghalin; depth 100 fathoms. Length 98 mm.

Distribution.—Known only from the type locality. Two specimens examined.

Relationships.—For comparisons with *P. deani* see description of latter species.

PARALIPARIS LIPARINA (Goode)

Amitra liparina Goode, 1880, Proc. U. S. Nat. Mus., vol. 3, p. 487.—Goode and Bean, 1895, Special Bull. U. S. Nat. Mus. No. 2, p. 278, fig. 252, (part).—Jordan and Evermann, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2138.

Monometra liparina Goode, Proc. U. S. Nat. Mus., 1883, p. 109.

Paraliparis liparina Günther, 1887, Challenger Rept., vol. 22, p. 68.—Garman, 1892 Mem. Mus. Comp. Zöol., vol. 14, No. 2, p. 82.

Type.—No. 26184, U.S.N.M.; *Fish Hawk* Station 891, southeast of Long Island, New York; depth 480 fathoms. Type lost.

Distribution.—Atlantic Ocean, southeast of New York. *Fish Hawk* Station 891 and *Albatross* Station 2586; depth 328–480 fathoms.

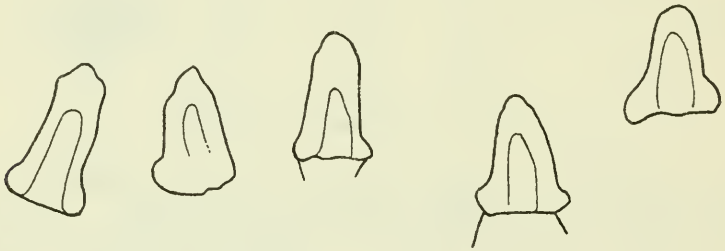

Figure 88.—Paraliparis liparina. Teeth from specimen No. 46002, U.S.N.M.

Relationship.—The author has been unable to demonstrate the presence of pseudobranchiae in the species and places it with *Paraliparis;* a pale colored species with the gill slit above the pectoral.

Description of No. 46002.—Dorsal 58; anal 55; pectoral 22; caudal 4; pyloric coeca 4. Depth 5.5; head 5.3. Eye 3.5 in the head.

Body slender, not attenuate, tapering gradually to the caudal. Head rather slender; occiput slightly swollen; cheeks vertical; profile concave over the eye. Mouth moderate; lower jaw included. Teeth simple but with a shoulder sometimes indicated, short and stout, very blunt, tuberclelike, not recurved, in moderate bands. Snout deep, abrupt, slightly projecting. Nostril without a tube. Eye large, black; pupil round. Gill slit uncertain. One suprabranchial pore present. No prickles. Pyloric coeca 6, on the left side.

Anterior 12 dorsal rays unsegmented. Caudal slender, truncate, connected for two-fifths of its length to the anal. Pectoral deeply divided; the upper lobe of 15 rays; the lower lobe of four elongated rays; the space between the two lobes divided by three rudimentary rays.

Color pale, pigmented with brown dots; these gathered about the mouth, along the back and toward the caudal and causing these regions to become dusky; peritoneum black; stomach pale.

From the type description: Dorsal 67; anal 54; pectoral 23; caudal 6. Depth 5.5, head 6.7. Orbit 5; snout 3.7.

PARALIPARIS ULOCHIR Gilbert

Paraliparis ulochir GILBERT, 1896, p. 441; 1915, p. 354.

Type.—Lost, U. S. National Museum Collection. *Albatross* Station 3010, Gulf of California; depth 1,005 fathoms.

Distribution.—Gulf of California and Bering Sea; *Albatross* Stations 3010 and 3332; depth 406 to 1,005 fathoms.

Relationships.—The distinguishing characters of the species are the high pectoral, large number of pectoral rays, the gill slit above the pectoral, and the black coloration.

Description of No. 48699 U. S. N. M.—A poorly preserved specimen from Station 3332, Bering Sea.

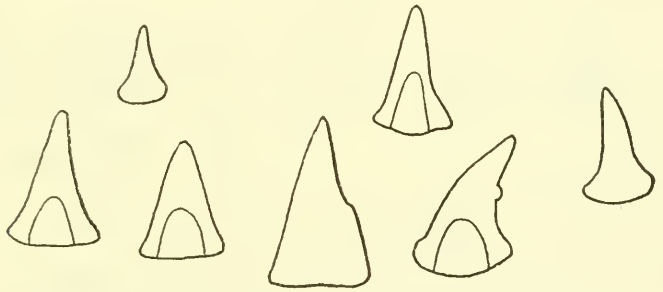

FIGURE 89.—PARALIPARIS ULOCHIR. TEETH FROM SPECIMEN NO. 48699, U.S.N.M.

Body tapering rapidly into an attenuate tail. Head short; interorbital flat; occiput slightly swollen, prominent. Teeth simple, short, conical, with a broad base, strongly recurved, sharply pointed, in narrow bands, arranged in oblique rows. Snout abrupt, deep. Nostril without a tube. Eye medium. Gill slit above the pectoral. One suprabranchial pore present. No prickles. Pyloric coeca on the left side, about 8. The upper edge of the pectoral on a level with the upper margin of the eye; the fin apparently not divided to the base; the lower lobe of short rays, bound in membrane nearly to the tip; the two lobes connected by four more widely spaced rays. Skin absent; the body pigmented with brown dots; mouth, gill cavity, peritoneum and the stomach black.

From the original description: Dorsal about 65; anal about 60. Head 5 in the length. Eye 3 to 3¼ in the head. Upper lobe of the pectoral extending beyond the anal origin; four or five somewhat widely spaced, well-developed rays connecting with the lower lobe;

lower lobe of nine rays; none of the rays are free. Uniformly black, including mouth and bronchial cavity.

PARALIPARIS MEMBRANACEOUS Günther

Paraliparis membranaceous GÜNTHER, 1887, p. 69, pl. 12, fig. D.—GARMAN, 1892, p. 83.

Hilgendorfia membranaceous GOODE and BEAN, 1895, p. 280.

Type.—British museum, *Challenger* Station 310, off Cape Saint Vincent; depth 400 fathoms. Length 60 mm.

Distribution.—Known only from type locality. Not examined.

Synopsis.—Dorsal about 70; anal about 70; caudal 2 or 3. Gill slit above base of pectoral fin. Teeth simple. A broad median dorsal fold arises from the top of the snout and is continued backward; anterior dorsal rays buried in this fold; pectoral broad, delicate, fringed. Body pale; peritoneum black.

PARALIPARIS BATHYBIUS (Collett)

Liparis bathybii COLLETT, 1878, p. 32; 1880, p. 52, pl. 2, fig. 14.—LÜTKEN, 1898, p. 17.—COLLETT, 1905, pl. 2, fig. 9.

Paraliparis bathybius GÜNTHER, 1887, p. 68, pl. 12, fig. C.—GARMAN, 1892, p. 81.

Type.—Female; Arctic Ocean, west of Bear Island, Norwegian North Atlantic Expedition, 1878, Station 312; depth 658 fathoms. Length 208 mm.

Distribution.—Arctic Ocean, region of the Faroe Island. No specimens examined.

Relationships.—*P. bathybius* agrees with *P. holomelas* in the reduction of the middle pectoral rays and the coloration.

Remarks.—A number of specimens have been recorded and described as belonging to the species. The descriptions of these latter specimens differ greatly from the original description as regards the pectoral fin.[17]

Synopsis.—Dorsal 59; anal 51; pectoral 19; caudal 8. Teeth simple. Gill slit probably above base of pectoral. Pectoral fin deeply notched; the presence of rudimentary rays connecting the two lobes uncertain. Color black.

PARALIPARIS AUSTRALIS Gilchrist

Paraliparis australis GILCHRIST, 1904, p. 107, pl. 7.

Type.—Two; off Cape of Good Hope; depth 300 fathoms. Length 50 mm.

Distribution.—Known only from type locality. No specimens examined.

Relationship.—*P. australis* resembles *P. garmani* and *P. bathybius* of the North Atlantic in the loss or great reduction of the rays connecting the two lobes of the pectoral fin. It can readily be distin-

[17] See Günther, Lütkin, and Collett.

guished from *P. garmani* by the horizontal mouth and from *P. bathybius* by the lighter coloration.

Synopsis.—Dorsal 48; anal 43; pectoral 14–3; caudal 9. Gill slit probably above base of pectoral. The two lobes of the pectoral separated by a space free of rays. Color pale; visceral mass black. Only the types known.

PARALIPARIS MELANOBRANCHUS Gilbert and Burke

Paraliparis melanobranchus Gilbert and Burke, 1912*b*, p. 378.

Type.—No. 73346, U.S.N.M.; *Albatross* Station 5029, Okhotsk Sea; depth 440 fathoms. Length 84 mm.

Distribution.—Known only from the type locality.

Relationships.—The distinguishing characters of this species are the small number of pectoral rays, the gill slit above the pectoral, and the pale coloration.

Description of type.—Dorsal 60; anal 53; pectoral 17; caudal 4; pyloric coeca 7. Depth 5.1; head 4.7. Eye 3.7; gill slit 6.1.

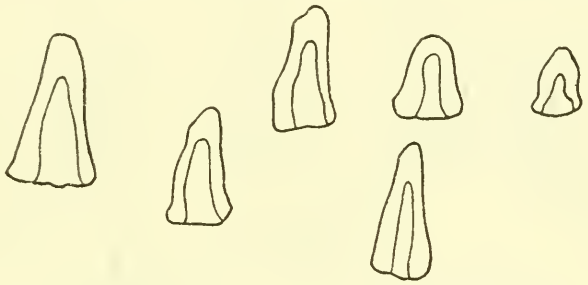

Figure 90.—Paraliparis melanobranchus. Teeth from type

Body deepest at the nape, tapering into an attenuate tail as in *P. cephalus*. Head comparatively heavy; occiput swollen, prominent; profile straight from occiput to snout. Mouth horizontal; angle of mouth under pupil. Teeth simple, short, stout, blunt, little recurved, in broad bands, arranged in about 12 oblique rows in the half of each jaw; inner teeth not prominent, little larger than anterior teeth. Snout deep, abrupt, not projecting; jaws equal. Nostril with a raised rim. Eye large, pupil round. Gill slit small, above the pectoral. One suprabranchial pore present; pores on the head normal. No prickles. Pyloric coeca 7, on the left side.

Anterior dorsal rays short, free from the membrane. Increasing gradually in length, eight or more unsegmented. About three anal rays unsegmented. Caudal truncate, connected for one-third its length to the anal. Pectoral notched deeply but not to the base; the two lobes connected by three widely spaced rays; lower lobe of four nearly equal rays, reaching midway between vent and anal, two in the head. Vent in front of gill slit.

Skin transparent, sparsely dotted; flesh dusted with brown dots; chin dusky; gill cavity, mouth, peritoneum, and stomach black.

PARALIPARIS LATIFRONS Garman

Paraliparis latifrons Garman, 1899, Mem. Mus. Comp. Zoöl., vol. 24, p. 118, pls. 27–28.

Types.—Seven; No. 28698, M. C. Z.; *Albatross* Station 3382, Pacific Ocean, off Panama; depth 1,793 fathoms. Length 145 mm. or less.

Distribution.—Known only from the type locality. Types examined.

Relationship.—In the shape of the head and body and the enlarged pores *P. latifrons* resembles *P. holomelas*; for differences see description of the latter species.

Description of one of the types.—Dorsal 53; anal 47; pectoral about 23; caudal 6; pyloric coeca 7. Depth 5.1; head 4.3. Eye 4.3 in the head.

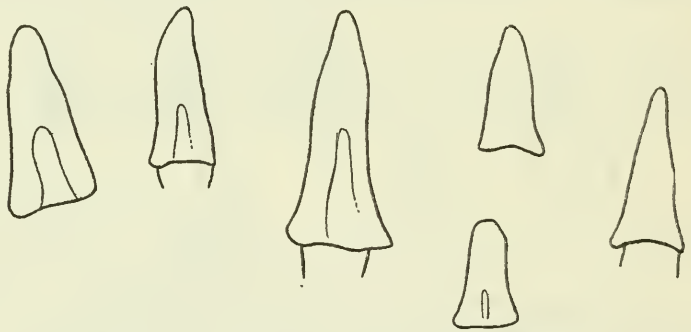

Figure 91.—Paraliparis latifrons. Teeth from type

Body heavy and deep at the nape, tapering rapidly into the slender compressed tail. Head heavy and deep; depth 5.1; width 6.5; cheeks vertical; occiput high. Mouth broad; the lateral cleft extending beneath the middle of the eye; maxillary extending beneath the posterior margin of the orbit. Teeth simple, slender, not recurved, arranged in narrow bands, the inward diverging rows very oblique; inner teeth longer and comparatively blunt. Snout deep, abrupt, not projecting. Nostril uncertain. Eye large, black; pupil large, round. Gill slit uncertain, the membrane macerated. Pores on the head enlarged as in *P. holomelas*; suprabranchial pore uncertain. No prickles. Pyloric coeca short, on the left side.

Origin of dorsal above the base of the pectoral. Caudal slender, of four or six rays. Pectoral divided nearly to the base; the upper edge below the level of the orbit; the two lobes connected by widely spaced rudimentary rays; the lower lobe of five elongate rays; the first ray shorter. In two specimens the eggs are 4 mm. in diameter.

Color: Remnant of skin black, apparently uniformly black; flesh pigmented; mouth, gill cavity, and the peritoneum black; stomach pale.

From the original description: D. 55; A. 47–49 P. 18–1–1–4 or 5. Head nearly 6 in the total length. Eye 3.3 in the head. Bones of the head thin and fragile. Upper portion of the pectoral with about 18 rays, separated from the lower lobe by two short rays; the longest rays nearly as long as the head; the majority of the rays have filamentous tips. Black on the side, abdomen, fins, and the lower surface of the head; remainder blackish to clouded brownish. Length 5 inches or more.

PARALIPARIS HOLOMELAS Gilbert

Paraliparis holomelas Gilbert, 1895, Rept. U. S. Fish Comm., 1893, p. 441.—Jordan and Evermann, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2140.—Evermann and Goldsborough, 1907, Bull. U. S. Fish Comm., vol. 26, p. 334, (part).

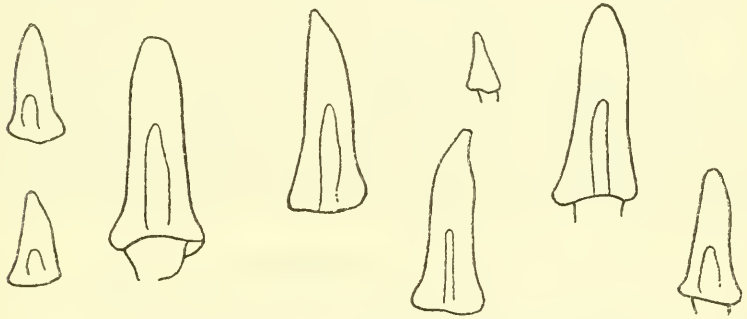

Figure 92.—Paraliparis holomelas. Teeth from type

Type.—Female, No. 48637, U.S.N.M.; *Albatross* Station 3332, north of Unalaska, Bering Sea; depth 406 fathoms.

Distribution.—Bering Sea; *Albatross* Stations 3332 and 3308; depth 406 to 1,625 fathoms. Type examined.

Relationships.—Apparently closely related to *P. latifrons*; possibly distinguished by the black stomach and the larger number of fin rays.

Description of type.—Mutilated. Body deepest at the nape, sloping rapidly to the elongate slender tail; the trunk short, not equal to the head. Head heavy, deep, occiput high, swollen; profile not concave over the eyes; interorbital high; cheeks nearly vertical; mouth broad; the lateral cleft extends nearly to the posterior margin of the eye, maxillary reaching a vertical from behind the posterior margin of the orbit. Teeth as in *P. latifrons*, simple, not recurved, few, moderately elongate, bluntly rounded at the tip, in narrow bands; the oblique rows obscure; inner teeth prominent. Snout abrupt. Nostril close in front of the eye; the character of the tube uncertain. Eye large, black, 4 in the head. Gill slit large, 2.4 in the head, extending down in front of 13 pectoral rays. Pores on the head enlarged, oval; one

suprabranchial pore; snout pores close together; the upper one nearly between the nostrils; the anterior pore reduced in size. No prickles. Pyloric coeca 8, on the left side, short, about equal to the pupil.

Dorsal rays very slender, the anterior rays increasing gradually in length, apparently not buried in tissue, the membrane absent. Caudal absent. Pectoral 23, deeply divided; the two lobes connected by two or three rudimentary, widely spaced rays; the upper lobe long, reaching past the front of the anal; the lower lobe of five filamentous rays free to their base, the longest reaching the anal, 1.2 in the head, the shortest not half the longest; the rays not regularly graduated in length as in *Liparis*. Snout to vent 4 in the head. The type is a female with eggs. Color black; peritoneum and stomach black; pyloric coeca white; mouth and gill cavity dusky to black.

From the original description: Head about 5; depth about 6. Dorsal 58 to 61; anal 54. Eye 3.7 in the head. Very large mucous slits on head, five forming a series from tip of snout below eye and across cheeks, six along mandible and preopercle. No pseudobranchiae. Pectoral inserted low, the upper edge below the level of the eye; the two lobes distinct, the interspace without free membraneous margin, the skin of the abdomen directly continuous at this point with that of shoulder girdle; beneath the integument the interspace between the lobes is provided with two or three short widely spaced rays, as in all other species examined by us.

PARALIPARIS GARMANI Burke

Amitra liparina Goode and Bean, 1895, p. 278 (part, confused with *P. liparina*). *Paraliparis garmani* Burke, 1912*a*, p. 572.

Type.—No. 64129, U.S.N.M.; *Albatross* Station 2586, off New England; depth 328 fathoms. Length 141 mm.

Distribution.—Atlantic Ocean off New England. *Albatross* Stations 2212, 2586, 2676; *Fish Hawk* Stations 898, 937, 952, 994, 997, 1093; depth 300 to 542 fathoms. Fifteen specimens examined.

Relationships.—*P. garmani* does not closely resemble any known species of the North Atlantic Ocean. It has been confused with *P. liparina* by various writers but can readily be distinguished from the latter species by the oblique mouth and the more elongate, slender, and recurved teeth. In these two characters *P. garmani* resembles *P. cephalus* of the Pacific Ocean. It differs from the latter species, however, in the larger number of pectoral rays and the more rudimentary condition of the middle pectoral rays.

Synopsis.—Dorsal 54; anal 49; pectoral 21; pyloric coeca 6. Depth of body 4.6 in length without caudal. Mouth oblique, symphysis of lower jaw projecting. Teeth simple, comparatively stout, sharply pointed, recurved, in broad bands. Gill slit above the pectoral. Middle pectoral rays rudimentary, hidden beneath the skin; lower lobe of the pectoral 2.9 in the head. No prickles. Color pale, dusky

posteriorly; mouth and stomach pale; peritoneum black. Reaching a length of 141 mm.

Remarks.—The head of the young resembles that of *P. cephalus*, the occiput being greatly swollen, not so pronounced in the adult. The maxillary reaches from beneath the middle of the eye to the posterior margin. Tail very slender and attenuate, appearing short, slender, and attenuate in the young when contrasted with the deep head and trunk. Pores normal for the genus. Pseudobranchiae absent. About 10 of the dorsal rays unsegmented. Caudal comparatively broad, truncate, connected for half its length to the anal, the dorsal and anal connections nearly equal. Pectoral divided into

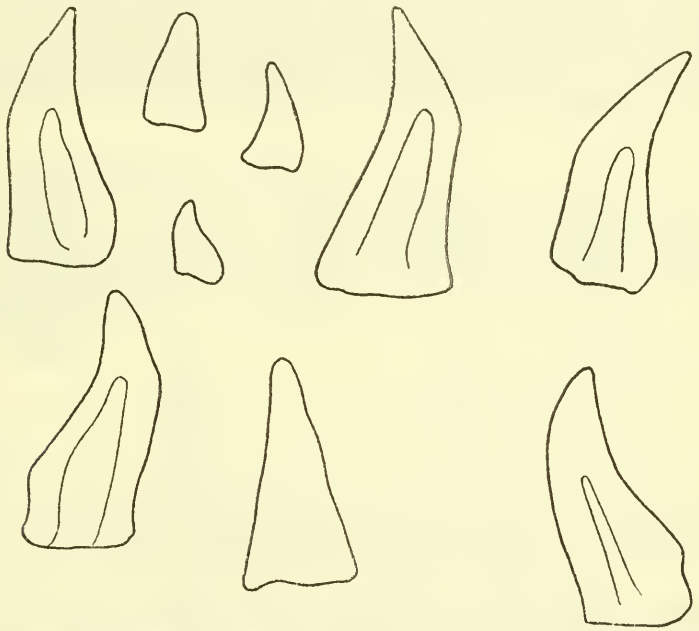

FIGURE 93.—PARALIPARIS GARMANI. TEETH FROM TYPE

two distinct lobes; the upper edge on a level with the lower margin of the eye or below; the upper lobe of about 14 rays; the lower lobe of three or four elongate rays, not graduated in length as in *Liparis*, equal to twice the eye, the tips sometimes coiled; the space between the two lobes bridged by four rudimentary rays.

PARALIPARIS CEPHALUS Gilbert

Paraliparis cephalus GILBERT, 1891, Proc. U. S. Nat. Mus., vol. 14, p. 561.—JORDON and EVERMANN, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2141.—GILBERT, 1915, p. 354.

Type.—Apparently lost, U.S.N.M.; *Albatross* Station 2892, off southern California; depth 284 fathoms. The type not seen by the writer. Four cotypes are in the Stanford Museum, No. 21.

Distribution.—Coast of California and northward to Bering Sea; *Albatross* Stations 2892, 3112, 3126, 3330, 3348, and from Karluk; depth 284–455 fathoms. Sixteen specimens examined.

Relationships.—Not closely related to any known species. For comparision with *P. mento* see description of the latter species.

Description of cotypes.—No. 21, S. U. Z. M. Body deep at the union with the head; the dorsal outline descending rapidly to the attenuate tail; distance from tip of opercle to posterior end of body cavity equal to the snout and orbit. Head 4.5 in the body length, deep, compressed; cheeks vertical; occiput greatly swollen. Mouth at an angle, pointing obliquely upward; maxillary reaching beneath the posterior margin of the orbit. Teeth simple, slender, sharply pointed, recurved, in narrow bands; the inwardly diverging rows very oblique and difficult to count. Snout short, rising abruptly to the nasal region; jaws nearly equal; the symphysis of the lower jaw sharp,

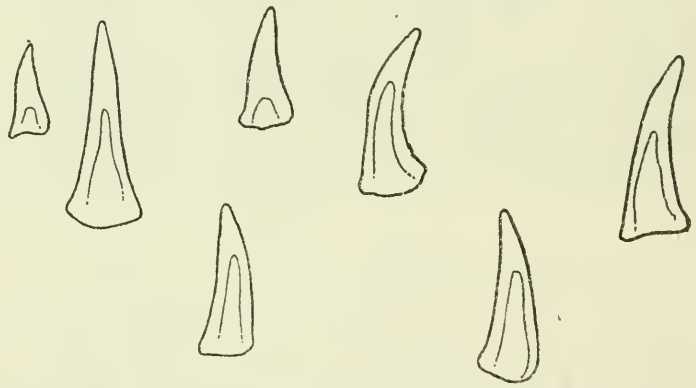

FIGURE 94.—PARALIPARIS CEPHALUS. TEETH FROM SPECIMEN NO. 5785, STANFORD UNIVERSITY ZOOLOGICAL MUSEUM

projecting. Nostril without a distinct tube. Eye moderate, 4 or less in the head. Gill slit described as being above the base of the pectoral, in all our specimens the membrane is torn. Pores appearing enlarged when the skin is absent; only one suprabranchial pore present. No prickles. Pyloric coeca 9, on the left side.

Origin of the dorsal over the end of the first third of the pectoral fin. Caudal very slender, elongate, of three rays, equal to the snout and orbit, connected for one-third its length to the anal. Pectoral low, the upper edge below the orbit and above the angle of the mouth, deeply notched but not to the base; the lower lobe consists of three exserted half free rays; the upper lobe consists of eight rays which form the body of the lobe and three shortened, not rudimentary, widely spaced rays which span the notch; these three rays are equal to one-half the length of the longest ray in the upper lobe; symphysis of the pectoral under the posterior border of the orbit. Vent just in

front of the gill slit; distance from tip of lower jaw to vent 5.5 in the length of the body.

Flesh pinkish, dotted; mouth and gill cavity pale, dotted; skin thin, transparent; stomach and peritoneum black.

Remarks.—Mouth and gill cavity sometimes blackish; peritoneum sometimes only heavily pigmented, possibly black in life. The Karluk specimens appear to have the mouth more horizontal and may belong to a different species.

PARALIPARIS MENTO Gilbert

Paraliparis mento GILBERT, 1891, Proc. U. S. Nat. Mus., vol. 14, p. 562.—JORDAN and GILBERT, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2142.—GILBERT, 1915, p. 354.

Type.—No. 44298, U.S.N.M.; *Albatross* Station 3071, coast of Washington; depth 685 fathoms. Length 87 mm.

Distribution.—Off Washington and California. Type examined.

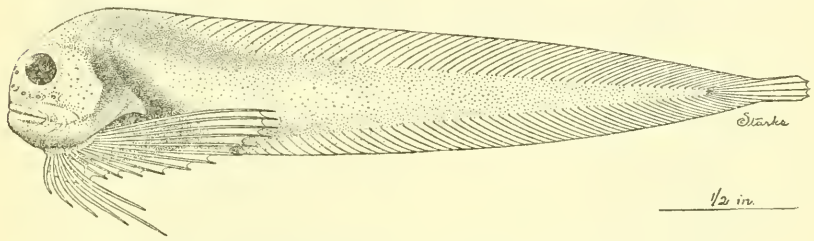

FIGURE 95.—PARALIPARIS MENTO. TYPE, SHOWING PECULIAR SHAPE OF HEAD

Relationships.—Not closely related to any known species; resembling *P. cephalus;* distinguished from the latter species by the more elongate body, the extremely low pectoral, and in minor characters.

Description of type.—Dorsal 57; anal 52; pectoral 16; caudal 4; pyloric coeca 8. Depth 6; head 5.7 Eye 3; gill slit 2.5.

Body slender, compressed, deepest at the union with the head, dorsal outline descending rapidly for a short distance, attenuate posteriorly; visceral cavity short; distance from tip of gill flap to the posterior end of the visceral cavity equal to the snout and one-half the eye. Head deep, compressed; occiput swollen; cheeks vertical, profile from upper lip to occiput almost straight. Mouth oblique, large; the angle beneath the eye; maxillary reaching beneath the posterior margin of the pupil, a little more than one-half the head. Teeth simple, rather slender, with a broad base, lanceolate, recurved, in a narrow band in the lower jaw, arranged in two or three very oblique rows; inner teeth larger and recurved; teeth in the upper jaw in a moderate band, the oblique rows close set. Snout retreating from the upper lip; lower jaw heavy, projecting upward; the symphysis very prominent. Nostril apparently without a tube projecting above

the skin. Eye moderate, black; pupil large, round. Gill slit large, above the pectoral, extending obliquely forward and downward; the opercular arm supporting the gill flap directed downward. Pores uncertain. No prickles. Pyloric coeca 8, on the left side.

Origin of dorsal above the gill slit; the anterior rays not buried in tissue. Caudal very slender, connected for one-half its length to the anal. Pectoral very low, the upper edge below the angle of the mouth; the base of the pectoral almost horizontal, the middle under the pupil; the pectoral symphysis under the chin; the lower lobe of elongate, partly free rays, coiled at the tips; the longest ray 0.9 in the head; the anterior ray one-half the longest; the rays not regularly

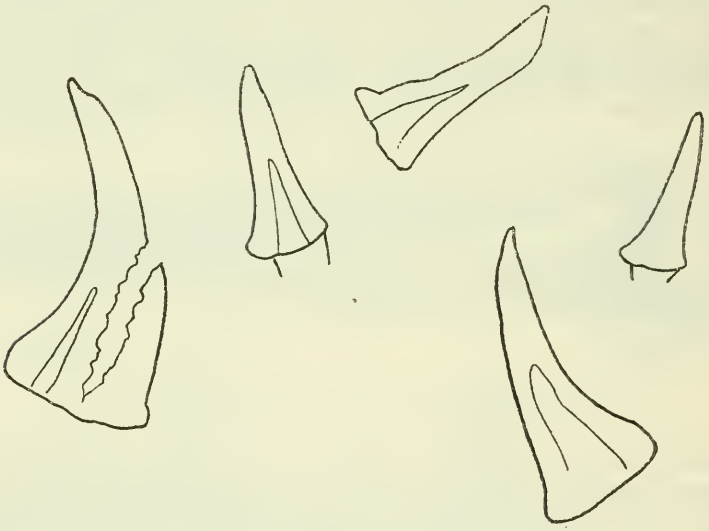

FIGURE 96.—PARALIPARIS MENTO. TEETH FROM TYPE

graduated in length as in *Liparis;* the upper lobe very slender, reaching the anal, the shortened rays widely spaced, distinct. Snout to vent 9.8 in the length; vent below the pupil.

Color: Skin absent; flesh pinkish; peritoneum black; color probably pale or pinkish in life.

PARALIPARIS ATRAMENTATUS Gilbert and Burke

Paraliparis atramentatus GILBERT and BURKE, 1912*b*, p. 377.

Type.—Male, No. 73345, U.S.N.M.; *Albatross* Station 4971, east coast of Hondo, Japan; depth 649 fathoms. Length 76 mm.

Distribution.—Known only from the type locality.

Relationship.—Apparently with the branch ending in the *P. rosaceus* group in which the teeth are stout and in a single row; differing from all the species with the teeth in bands by the extremely heavy teeth.

PARALIPARIS COPEI Goods and Bean

Paraliparis copei Goode and Bean, 1896, Special Bull. U. S. Nat. Mus., No. 2, p. 279, fig. 253.—Jordan and Evermann, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2143.

Type.—No. 35637, U.S.N.M.; *Albatross* Station 2237, southeast of Long Island; Depth 520 fathoms. Length 178 mm.

Distribution.—Atlantic Ocean off the New England coast; *Fish Hawk* Station 898; *Albatross* Stations 2186, 2237, 2586, 2722; depth 300–594 fathoms. Ten specimens examined.

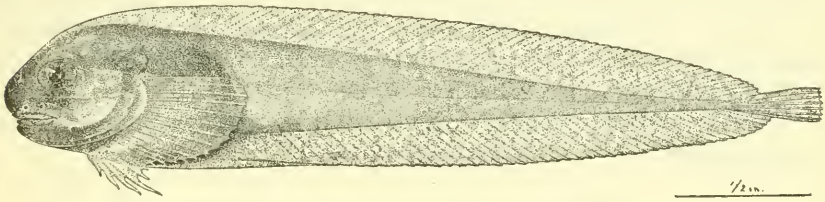

Figure 97.—Paraliparis atramentatus. A typical species of the genus. Type

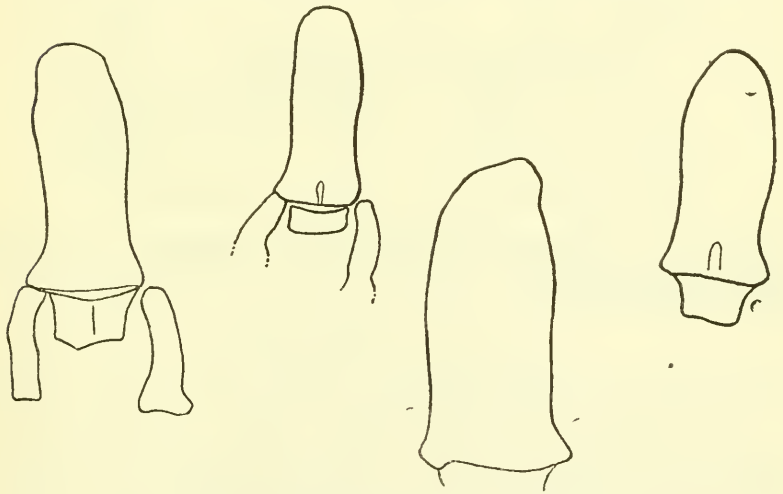

Figure 98.—Paraliparis atramentatus. Teeth from type

Relationships.—*P. copei* closely resembles *P. rosaceus* of the Pacific. The two species appear to differ in the length of the head, size of eye, and the distance from snout to vent. The material is not sufficient for making satisfactory comparisons.

Description of type.—Dorsal 60; anal 55; pectoral 20; pyloric coeca 6. Depth 6.5; head 6.5. Eye 3.6; gill slit 6.8.

Body comparatively heavy, compressed, elongate but not attenuate. Head wide, blunt; cheeks nearly vertical; occiput slightly swollen; interorbital comparatively wide; 2.9 in the head. Mouth with little

lateral cleft; maxillary reaching beneath pupil. Teeth simple, stout, wedge-shaped, in a single series in both jaws, forming a sharp cutting edge, more widely spaced and weaker at the symphysis; apparently fewer teeth in the upper jaw; pulp cavity small. Snout deep, abrupt, little if at all projecting. Nostril with a raised rim. Eye large, black, pupil round. Gill slit above the base of the pectoral. One suprabranchial pore present; upper pores on the snout nearly between the nostrils. No prickles. Pyloric coeca 3.2 in the head, on the left side.

Origin of dorsal slightly behind the middle of the pectoral; the anterior rays buried in tissue, depressed. Caudal of 6 rays, connected for one-half its length to the anal: the dorsal and anal connections gradual. Pectoral notched; the two lobes connected by rudimentary widely spaced rays; the lower lobe of three or four rays; the lower ray one-half the second, elongate; the lower lobe reaching past the vent, 1.6 in the head. Vent under the base of the pectoral.

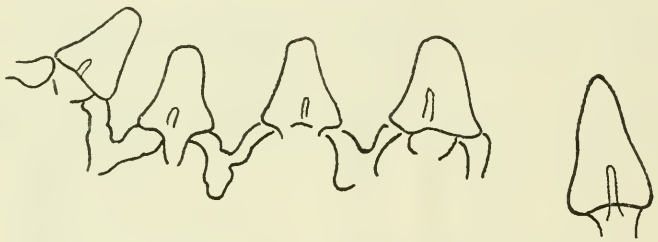

FIGURE 99.—PARALIPARIS COPEI. TEETH FROM SPECIMEN NO. 46009, U.S.N.M.

Body milky white anteriorly, light brown posteriorly; snout and chin blackish; gill cavity, a strip back of the vent, and the peritoneum black; stomach pale.

PARALIPARIS ROSACEUS Gilbert

Paraliparis rosaceus GILBERT, 1890, Proc. U. S. Nat. Mus., vol. 13, p. 93.—GARMAN 1892, Mem. Mus. Comp. Zoöl., vol. 14, No. 2, p. 80.—JORDAN and EVERMANN, 1898, Bull. U. S. Nat. Mus., No. 47, p. 2142.

Type.—No. 48918, U.S.N.M.; *Albatross* Station 2919, off southern California; depth 984 fathoms. Length 135+ mm.

Distribution.—Known only from the type locality. Type examined.

Relationships.—See description of *P. copei;* differing from *P. attenuatus* and *P. grandiceps* in the lighter coloration.

Description of type.—Pectoral 20; caudal 4; pyloric coeca 5. Depth 5.7; head 5. Eye 4.8; gill slit 6.5.

Body comparatively deep, compressed, moderately elongate, not attenuate, tapering gradually. Head not heavy or deep; occiput not swollen; cheeks vertical. Mouth horizontal, small, with little lateral cleft; maxillary reaching beneath the pupil. Teeth short, stout, appearing more bluntly rounded than in *P. copei*, those in the lower jaw in one row, forming a single cutting edge, teeth in upper jaw nearly

all absent, probably similar to the teeth in the lower jaw. Snout deep, rising steeply, not projecting. The nostril tube apparently not projecting above the surface of the head. Eye small, black; pupil round. Gill slit above the pectoral. One suprabranchial pore. Pyloric coeca about 5.

Origin of the dorsal over the middle of the pectoral; the anterior rays buried in tissue beneath the fin membrane. Caudal multilated, apparently connected for one-half its length to the anal. The upper edge of the pectoral on a level with the lower margin of the eye; the two lobes connected by rudimentary rays, a short space of the girdle bare as though one ray had been torn away; the lower lobe of four slender rays, 1.8 in the head. Snout to vent 5.9 in the length of the body.

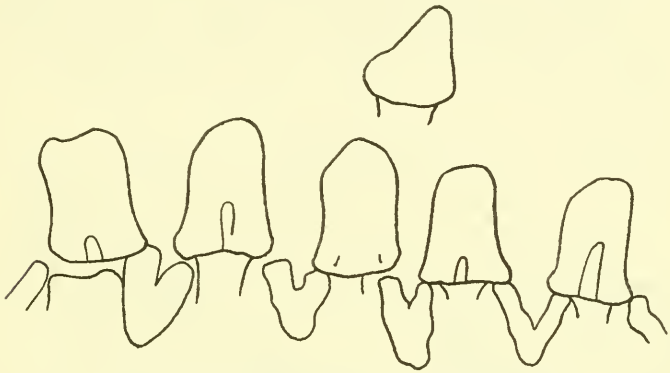

FIGURE 100.—PARALIPARIS ROSACEUS. TEETH FROM TYPE

Color pinkish; the head and fins black; mouth, gill cavity, and the peritoneum black; stomach pale.

PARALIPARIS GRANDICEPS Garman

Paraliparis grandiceps GARMAN, 1899, Mem. Mus. Comp. Zoöl., vol. 24, p. 117, pl. 29, figures 4–4*c*.

Type.—Female, No. 28701, M. C. Z.; *Albatross* Station 3434, Gulf of California; depth 1,588 fathoms. Length 10 inches.

Distribution.—Known only from the type locally. Type examined.

Relationships.—*P. grandiceps* is closely related to *P. attenuatus*. See description of the latter species.

Description.—Note on the type which is in a mutilated condition. Teeth resembling those in *P. copei and P. rosaceus*, on the lower jaw in a single series, crowded together at the symphysis into two or more rows, progressively larger at the sides; the teeth in the upper jaw not seen.

Pectoral divided nearly to the base; the space between the two lobes bridged by four widely spaced rudimentary rays; outline of fin as figured for *P. bathybius* in Plate 12 of the *Challenger* Report.

Peritoneum black; stomach pale.

From the original description: D. about 56; A. about 42; P. 15–1–1–1–1–5. Depth 5 in the total length; head about 6. Orbit less than three in the head. Evidently the form and proportion as in *P. bathybius*. Body compressed; caudal section thick, deep anteriorly and for some distance back of the body, then decreasing in depth rapidly and becoming thin and slender. Head as broad and deep as long, subquadrangular in transsection across the orbit; interorbital flattened. Cheeks swollen. Snout blunt, slighty overhanging the

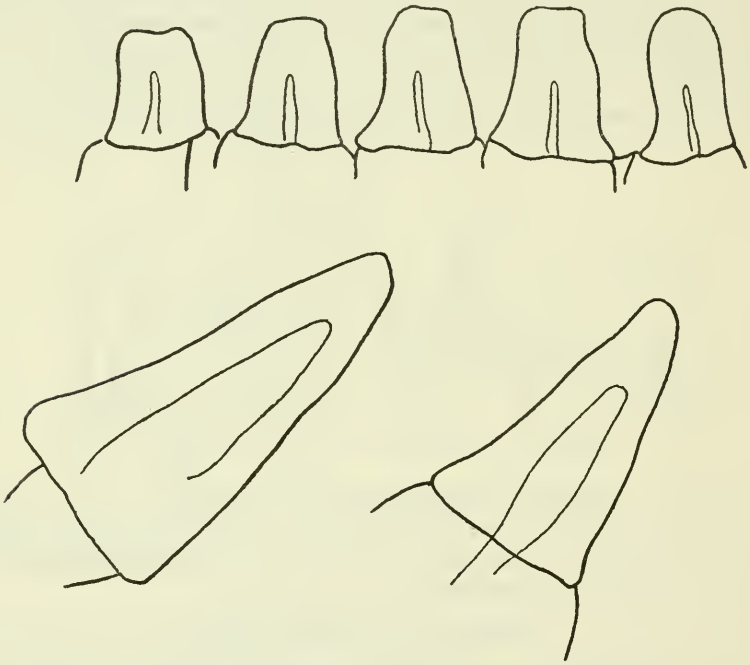

FIGURE 101.—PARALIPARIS GRANDICEPS. TEETH FROM TYPE

mouth. Mouth wide. Maxillary extending below the entire orbit. Teeth small, short, robust, blunt, subconical, with broad bases, firmly attached, in one series on each jaw except near tip of mandible where a second row may be present, larger toward the angle of the mouth.

Upper lobe of the pectoral of 15 rays, connected with the lower lobe by four short rays; lower lobe of five rays, nearly as long as the upper lobe; the four short rays occupying a space equal to the orbit, connected by membrane. Total length 10 inches. Color dark brown or black.

PARALIPARIS ATTENUATUS Garman

Paraliparis attenuatus Garman, 1899, Mem. Mus. Comp. Zoöl., vol. 24. p. 118.

Type.—No 28700, M. C. Z.; *Albatross* Station 3364, off Panama, Pacific Ocean; depth 902 fathoms. Length 3 inches.

Distribution.—Known only from the type locality. Type examined.

Relationships.—*P. attenautus* resembles *P. rosaceus in* the characters of the head, teeth, and body. It differs from the latter species in the darker coloration and from *P. grandiceps* apparently in the larger number of dorsal and anal rays.

Description.—Note on the type which is in a mutilated condition. Body slender, resembling *P. rosaceus.* Head as in *P. copei,* the profile evenly rounded; the occiput not swollen; depth of head greated than width. Mouth small, horizontal; maxillary reaching below the pupil. Teeth apparently in single rows as in *P. copei* and related species. Snout not projecting. Eye moderate, about 4 in the head, black. The character of the gill slit and the pores can not be ascertained. No prickles. Pyloric coeca, few, short. Pectoral notched nearly to the base, the two lobes connected by three rudimentary rays; the fin consisting of about 24 rays of which 4 are in the lower lobe. Caudal narrow, acuminate.

Skin absent, probably dusky or black; mouth, gill cavity, and the peritoneum black; stomach pale.

Note from the original description: D. 66; A. 57; P. 17–1–1–1–4. Depth 6 in the total length. Head less than 7. Head one-fourth deeper than wide, high at the nape. Mouth medium, horizontal. Teeth small, acuminate, in a single series. Color black, or lightening to brown on the posterior half. Total length 3 inches or more.

Genus RHINOLIPARIS Gilbert

Rhinoliparis Gilbert, 1895, Rept. U. S. Fish Comm., 1893, p. 445.

Disk absent; nostril single; teeth simple or trilobed; one suprabranchial pore; pyloric coeca present; barbels on the snout; pseudobranchiae absent; branchiostega rays 6.

Genotype.—Rhinoliparis barbulifer.

RHINOLIPARIS BARBULIFER Gilbert

Rhinoliparis barbulifer Gilbert, 1895, Rept. U. S. Fish Comm., 1893, p. 445.—Gilbert and Burke, 1912*b*, p. 379.

Type.—Female, No. 48576, U.S.N.M.; *Albatross* Station 3325, Bering Sea north of Unalaska; depth 284 fathoms. Length 110 mm.

Distribution.—North Pacific, off California, east coast of Hondo, Okhotsk Sea and Bering Sea; *Albatross* Stations 3325, 3327, 3329, 3331, 4540, 5019, 5028, 5039, 5043, 5044, 5045, 5050; depth 192–551 fathoms. Forty specimens examined.

Relationships.—*R. barbulifer* is not closely related to any known species.

Description of type.—Pectoral 20; caudal 3; pyloric coeca 7. Depth 6.6; head 5.3. Eye 3; gill slit 3.6.

Body slender, becoming very attenuate posteriorly. Head comparatively heavy; occiput slightly swollen; cheeks vertical; profile rising gradually from the snout. Mouth narrow; the lateral cleft extending to below the middle of the pupil; the maxillary reaching beneath the posterior margin of the eye. Larger teeth more or less strongly trilobed, not close set, in broad bands; the inner teeth

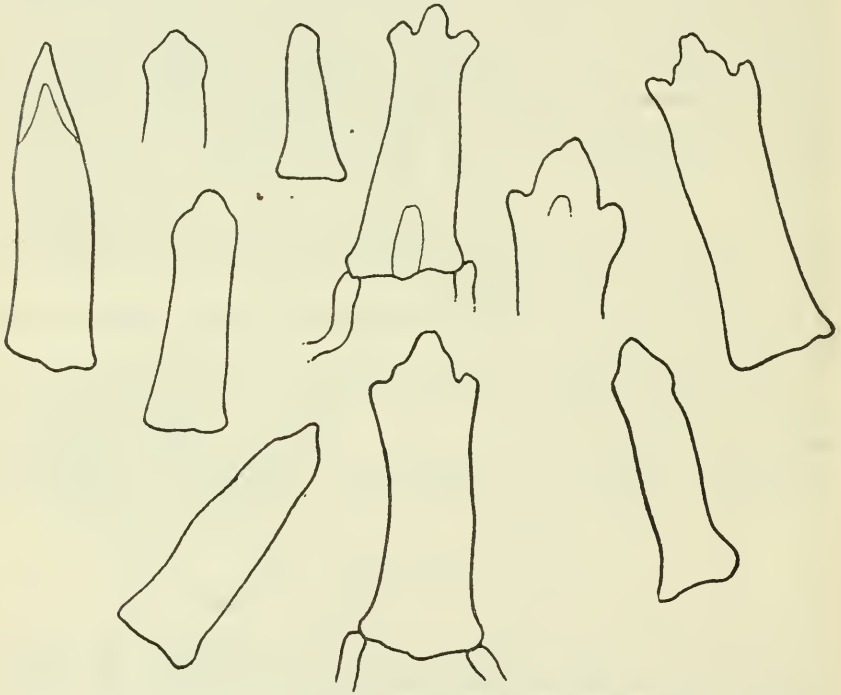

FIGURE 102.—RHINOLIPARIS BARBULIFER. TEETH FROM SPECIMEN FROM ALBATROSS STATION 5043, OFF HOKKAIDO, JAPAN

larger; nine oblique rows in the half of the lower jaw, distinct; the oblique rows in upper jaw indistinct. Snout low, projecting beyond the upper lip for the diameter of the pupil; two barbels on the tip of the snout, separated by three-fifths the length of the barbels; the length of the barbels about one-half the eye. Nostril tube not projecting above the skin. Eye large, black, far forward, the anterior margin above the tip of the lower jaw; pupil large, round. Gill slit extending down in front of five pectoral rays. Pores not enlarged; one suprabranchial pore present; the upper snout pore above the barbel; the anterior snout pore low; below and slightly to one side of

the barbel. No prickles. Pyloric coeca short, three-fourths of the eye, on the left side.

Origin of dorsal above gill slit; tips of anterior rays not connected with skin. Caudal of three rays, slender, truncate, 2 in the head, connected for one-fourth its length to the anal. The upper edge of the pectoral on a level with the pupil; the fin deeply notched; the space between the two lobes with two very widely spaced rudimentary rays hidden beneath the skin; the upper lobe not quite reaching the anal; the lower lobe reaching halfway to anal, 2 in the head, of three elongate, nearly equal rays, free nearly to the base, one short rudimentary ray in front, suggesting that the anterior rays have been lost; two-fifths of the length of the pectoral appears to be beneath the lax skin.

Color: Skin transparent; flesh dotted, dusky on the nape and along the base of the dorsal and anal; peritoneum, mouth, and gill cavity black; stomach dusky.

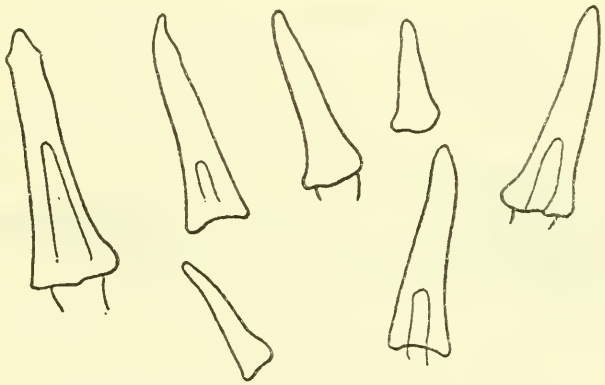

FIGURE 103.—RHINOLIPARIS ATTENUATUS. TEETH FROM TYPE

RHINOLIPARIS ATTENUATUS Burke

Rhinoliparis attenuatus BURKE, 1912*a*, p. 573.—GILBERT, 1915, p. 357.

Type.—No. 28377, M. C. Z. Bering Sea, *Albatross* Station 3326; depth 576 fathoms.

Relationships.—Rhinoliparis attenuatus constitutes the second species in the genus. It does not appear to be closely related to *Rhinoliparis barbulifer* and can zeadily be distinguished from the latter by the larger number of barbels on the snout and the more highly modified type of dentition.

Description of type.—Body as in *R. barbulifer*, low, extremely attenuate. Head 5.7 in the length of the body without the caudal, depressed; width of head greater than depth of head; profile low, nearly straight from snout to occiput; interorbital flattened. Mouth broad; maxillary reaching vertical from posterior margin of eye.

Teeth in narrow bands, elongate, slender, slightly recurved, simple or the lateral lobes faintly indicated on some of the teeth. Snout depressed, broad, projecting as in *R. barbulifer*, extending beyond the upper lip for three-fourths the diameter of the eye. The snout is somewhat mutilated but at least three barbels are present on each side; one of these is situated near the tip of the snout and two near the lateral margin of the lower surface. Nostril with a raised rim. Eye large, 4 in the head. Gill slit apparently above the base of the pectoral fin. Pyloric coeca about 12. One suprabranchial pore.

Caudal fin mutilated but apparently reduced to a single elongate ray, connected for a short distance with the dorsal and anal fins. Pectoral fin with a shallow notch; the middle rays well developed, widely spaced; the lower lobe of six elongate mainly free rays; the upper lobe of 16 rays.

The dermis absent, probably dusky or blackish; flesh pinkish; mouth dusky; peritoneum black; stomach pale or slightly dusky.

Genus ACANTHOLIPARIS Gilbert and Burke

Acantholiparis GILBERT and BURKE, 1912*a*, p. 83.

Disk absent; nostril single; teeth simple; one suprabranchial pore; pyloric coeac absent; pseudobranchiae absent; opercular arms pro-

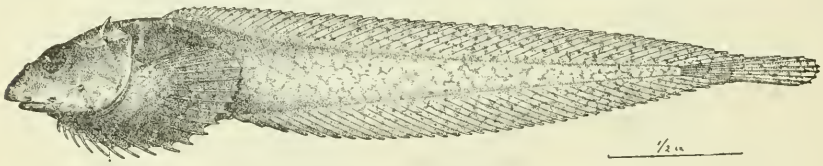

FIGURE 104.—ACANTHOLIPARIS OPERCULARIS. TYPE, SHOWING OPERCULAR SPINES FOUND IN NO OTHER SPECIES OF THE FAMILY

jecting as strong spines from sides of head; gill flap supported by the posterior arm of the suboperculum; branchiostegal rays 6.

Genotype.—Acantholiparis opercularis.

ACANTHOLIPARIS OPERCULARIS Gilbert and Burke

Acantholiparis GILBERT and BURKE, 1912*a*, p. 83.

Type.—No. 74390, U.S.N.M.; *Albatross* Station 4797, off Staritschkof Island, Kamchatka; depth 682 fathoms. Length 76 mm.

Distribution.—North Pacific, *Albatross* Stations 4761 and 4797; depth 682 to 1,973 fathoms.

Description of the type.—Dorsal 45; anal 39; pectoral 26; caudal 10; pyloric coeca absent. Depth 7; head 4.6. Eye 4.8; snout 3.

Head and body as in *C. ectenes;* body slender, depressed. Head broad, depressed, flat. Snout low, wide, projecting over the broad mouth. Mouth broad; maxillary reaching below the posterior margin of the pupil. Teeth fine, conical, in moderate bands, the tip

slightly recurved. Nostril in a slender tube. Eye moderate; pupil oval. Gill slit above the pectoral. One suprabranchial pore; upper snout pore far forward toward the tip of the snout. No prickles. Pyloric coeca absent in cotype, apparently absent in the species.

Origin of dorsal a short distance behind the base of the pectoral; caudal slender, strong, 1.2 in the head; connected for one-fourth its length to the anal. Pectoral broad, reaching the anal, unnotched, anterior rays progressively shortened as in the lower lobe of the fin in *Liparis;* anterior rays free nearly to the base. Vent midway between the tip of the lower jaw and the anal fin.

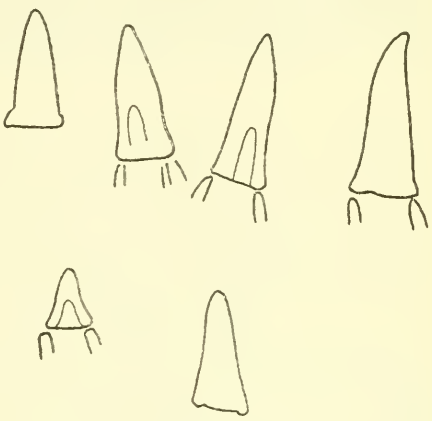

FIGURE 105.—ACANTHOLIPARIS OPERCULARIS. TEETH FROM COTYPE

Color dusky to grayish, paler posteriorly; lower surface of the head, snout, mouth, interorbital, pectorals, and the abdomen dusky; peritoneum dusky to black; stomach dusky to pale. In life dusky reddish throughout.

Genus NECTOLIPARIS Gilbert and Burke

Nectoliparis GILBERT and BURKE, 1912*a*, p. 82.

Disk absent; nostril single; teeth simple; gill slit restricted to the front of the pectoral; one suprabranchial pore; pyloric coeca present; vent horizontal, on the throat, opening forward; branchiostegal rays 5; one of the anterior rays lost; pseudobranchiae absent.

Genotype.—Nectoliparis pelagicus.

NECTOLIPARIS PELAGICUS Gilbert and Burke

Nectoliparis pelagicus GILBERT and BURKE, 1912*a*, p. 82; 1912*b*, p. 380.

Type.—No. 74389, U.S.N.M.; *Albatross* Station 4785, off Attu Island, Bering Sea, depth 400 fathoms. Length 30 mm.

Distribution.—North Pacific, southern California to Hokkaido, Japan; *Albatross* Stations 4252, 4257, 4258, 4333, 4539, 4541, 4765, 4767, 4781, 4785, 4800, 5032, and 5039; depth intermediate, 300 to 609 fathoms. Fifteen specimens examined.

Relationships.—Resembling *Paraliparis* in the reduction of the pectoral rays, and coeca and the character of the teeth. Widely divergent in the loss of one of the branchiostegals.

Description of the type.—Dorsal 53; anal 48; pectoral 19; caudal 6; pyloric coeca 8; depth 4.8; head 4.2. Eye 2.7 (from a cotype).

Body comparitively robust, dorsal outline descending very gradually to the caudal. Head compressed; cheeks vertical; interorbital flat; occiput deep; profile rounded. Mouth terminal, pointing obliquely upward; maxillary reaching below the pupil. Teeth extremely small, mere conical tubercles, difficult to see with a hand lens, in a single series, not close set; possibly absent at the symphysis;

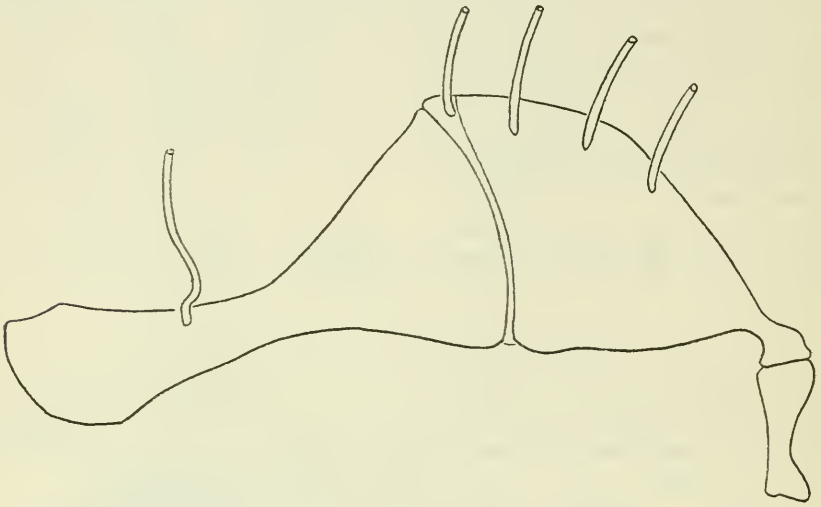

FIGURE 106.—NECTOLIPARIS PELAGICUS. PECTORAL GIRDLE WITH FIVE BRANCHEOSTEGAL RAYS

not seen in upper jaw. Snout short, abrupt, 3 in the head; jaws nearly equal, the lower jaw appearing larger when the mouth is open. Nostril with a raised rim. Eye large, prominent; pupil round. The gill slit is confined to the front of the upper pectoral lobe and extends in front of 14 rays. One suprabranchial pore; upper snout pore high,

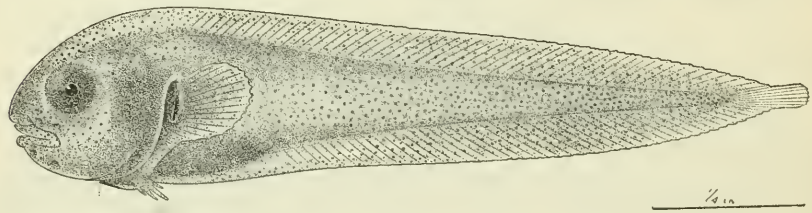

FIGURE 107.—NECTOLIPARIS PELAGICUS. TYPE. SHOWING LOCATION OF VENT AND PECULAR PECTORAL

higher than the nostril; nostril nearly between the two snout pores; six pores on the maxillary and about the eye, six or more in a series on the mandible and cheeks. No prickles. Pyloric coeca 8, one-half the eye, on the left side.

Dorsal origin far back, over the tip of the pectoral. Caudal truncate, of four or six rays, connected for nearly one-half the length

to the anal. Pectoral divided to the base; the lobes far apart, separated by nearly the diameter of the eye; the upper lobe reaching nearly to the anal, of 13 or 14 well-developed rays and two or three rudimentary, widely spaced rays, these not bridging the gap between the two lobes; lower lobe of four rays, short, (variable in the cotypes, of three or four rays, sometimes elongate, as long as the upper lobe; the rays sometimes half free, not graduated in length), the anterior ray shorter. Vent far forward on the chin; snout to vent 2 in the head; vent in front of the base of the lower pectoral lobes, above a horizontal forward projecting fold with the anal papilla at the tip, this fold filled by the rectum and the oviduct. In one specimen 18 rays in the dorsal and 12 in the anal are unsegmented.

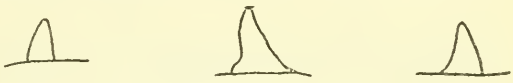

FIGURE 108.—NECTOLIPARIS PELAGICUS. TEETH FROM TYPE

Color pale, heavily pigmented with black dots; skin transparent, dotted on the head and the posterior part of the body; flesh more heavily pigmented, sometimes very dark; abdomen and the cheeks sometimes silvery; stomach and coeca pigmented, mouth, gill cavity, and the peritoneum black. Reaching a length of 64 mm.

APPENDIX

Included in the appendix is one species which is doubtfully placed with the Liparidae and a number of species described since the present report was completed. The writer deems it advisable not to attempt to include these species in the body of the text because in some cases the descriptions are incomplete and specimens are not available for examination. Attempting to determine the relationships of the Liparids with incomplete descriptions and without specimens is a hopeless task.

LIPARIS OSBORNI Townsend and Nichols

Liparis osborni TOWNSEND and NICHOLS, 1925, p. 14, fig. 4.

Described from California.

GYMNOLICODES EDWARDSI Vaillant

Gymnolicodes edwardsi VAILLANT, 1888, pp. 313 and 387, pl. 26, fig. 3.—BOULENGER, Zool. Record, 1888, Pisces, p. 18.—GOODE and BEAN, 1895, p. 281-fig. 254.

The relationships of this species are unknown. I do not believe that it belongs with the Discoboli. It differs from any known deep-sea Liparid in having the vent far back near the anal fin. The pectoral fin also differs widely from that of any known Liparid.

CAREPROCTUS DUBIUS Zugmayer

Careproctus dubius ZUGMAYER, 1911, p. 9.

Described from Spitzbergen.

CAREPROCTUS BURKEI Jordan and Thompson

Careproctus burkei JORDAN and THOMPSON, 1914, p. 281, pl. 34, fig. 2 and 2*a*.

Type.—No. 6457; Carnegie Museum, a female 92 mm. in total length, and a female cotype, 83 mm. long, both from Yokohama market, doubtless outside the heads of Awa and Bashu.

CAREPROCTUS JORDANI, new name

Careproctus gilberti JORDAN and THOMPSON, 1914, p. 282, pl. 34, fig. 1 and 1*a*.

This species was described as *Careproctus gilberti* by Jordan and Thompson in 1914. Unfortunately the present writer (1912*a*) had used the same specific name for another species of *Careproctus*. We therefore submit the name *jordani* for this species and repeat Jordan and Thompson's original description:

Description from the type, No. 6456, a specimen much shrunken by strong alcohol, from Misaki, Sagami Bay, Japan, 16 cm. in total length. The measurements are given in hundredths of body length to correspond with the comprehensive paper recently published by Gilbert and Burke on the Japanese Cyclogasteridae.

Head .25; width of same .17; centerocular width .10; width at engle of mouth .12; length of snout .09; eye .06; maxillary .12; width of gill slit .06; depth of body .19; distance from snout to disk .19; from snout to anus .34; snout to anal fin .42; snout to dorsal insertion .28; transverse diameter of disk .08; distance disk to anus 7; longest ray in upper pectoral lobe 17, in lower lobe 12; D. 45; A. 38; P. 32.

Body elongate, compressed; head deeper than wide; dorsal profile most strongly curved on snout; jaws subequal; maxillary extending to below anterior border of pupil; eyes high, reaching dorsal profile as in *Careproctus curilanus;* nostril at level of upper edge of pupil; teeth coarse, in bands in both jaws, simple, not triolbed, depressible. Gill opening extending to second pectoral ray. Pectoral not deeply notched, rays of lower lobe slightly produced as filaments. Anterior dorsal rays half length of posterior rays; latter .10 of body length; former with tips slightly produced; first anal ray .07, last .10; dorsal and anal adnate to caudal by one-fourth its length; last ray in each slightly shorter than preceding ray. Disk beginning under, or slightly behind, posterior margin of eye and reaching to below point of opercle, separated by its own transverse diameter from anus, which resembles that of *Careproctus pycnosoma* in position.

Color faded or lacking. Peritoneum jet black.

CAREPROCTUS SARASA Tanaka

Careproctus sarasa TANAKA, 1916, p. 173.

CAREPROCTUS PUNCTULATUS Tanaka

Careproctus punctulatus TANAKA, 1916, p. 173.

CAREPROCTUS OKADAE Tanaka

Careproctus okadae TANAKA, 1916, p. 173.

CAREPROCTUS MEDERI Schmidt

Careproctus mederi SCHMIDT, 1915, p. 628, figs. 7–8.

Okhotsh Sea.

PARALIPARIS ALBESCENS Gilbert

Paraliparis albescens GILBERT, 1915, p. 355.

Type.—Cat. No. 75816, U.S.N.M.; a female with well-developed ova, 63 mm. long, from Station 4515, Monterey Bay. Only the type known.

PARALIPARIS CAUDATUS Gilbert

Paraliparis caudatus GILBERT, 1915, p. 355.

Type.—Cat. No. 75815, U.S.N.M.; 86 mm. in total length, (77 mm. to base of caudal), from Station 4527, Monterey Bay. Only the type known.

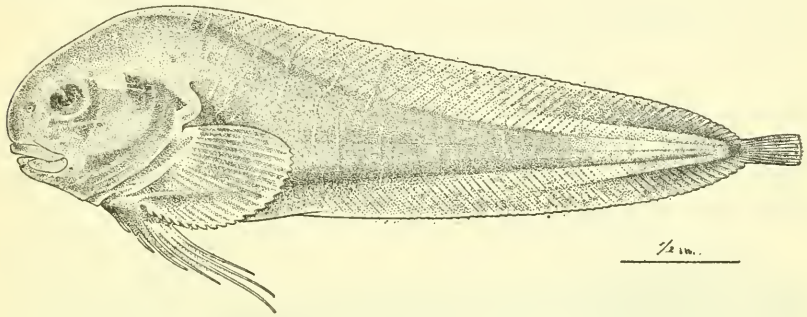

FIGURE 109.—PARALIPARIS CAUDATUS. TYPE. ONE OF THE SHORTER, DEEPER BODIED SPECIES RESEMBLING SPECIES OF CAREPROCTUS

Resembling *P. ulochir* in the restricted gill slit and the wide pectoral, but differing among other characters in the shorter, deeper body, and the wider, many-rayed caudal fin. In *P. ulochir,* the trunk tapers to an extremely slender tail, the fin composed of but four rays. In *P. caudatus,* the base of the caudal has an easily appreciable width and the fin contains 10 or 11 rays.

PARALIPARIS ANTARCTICUS Regan

Paraliparia antarcticus REGAN, 1914, p. 11.

PARALIPARIS TERRAE-NOVAE Regan

Paraliparis terrae-novae REGAN, 1916, p. 129, pl. 1, fig. 6.

The original description is as follows:

A young fish, 35 mm. long, was taken in McMurdo Sound on January 16, 1912, at Station 332, 77° 15′ S., 166° 0′ E., 0–550 meters. It is very similar in most respects to *Paraliparis antacticus* Regan, but differs notably in the fewer fin rays, (dorsal 55; anal 43) and in the form of the pectoral fin, which has no elongate lower rays. This is the second Antarctic species of the genus.

PARALIPARIS WILDI Waite

Paraliparis wildi WAITE, 1916, pl. 4, fig. 1.

The following is from the original description:

Locality.—The only specimen was taken at Station X., lat. 65° 6′ S., long. 96° 13′ E.; off Shackleton Iceshelf, in 325 fathoms, the temperature being 1.65 C., and the bottom ooze.

Remarks.—This species differs from *P. antacticus* Regan, the only other species described from Antarctica, in the following characters: The eye is slightly smaller and the snout longer; the pores on the head are more numerous, occurring on the snout, none being so figured in *P. antarcticus*. The shape of the vertical fins is different, while the caudal is partly enclosed by the dorsal and anal membranes; the vent occupies a forward position, behind the lower portion of the pectoral, as is usual in these forms, while Regan's statement that these lower portions reach the vent would indicate that the latter is placed quite near the origin of the anal fin, and therefore, in a position normal to the majority of fishes. *P. wildi* appears to be more nearly allied to the northern *P. bathybii* Collett, the type of the genus.

Addendum.—*P. terrae-novae* Regan differs more from *P. antarctica* than does *P. wildi*, possessing fewer fin rays, and having no elongate lower rays in the pectoral. Three species are now known from the Antarctic.

Type in the South Australian museum.

Genus LIPARISCUS Gilbert

Lipariscus GILBERT, 1915, p. 358.

Allied to *Paraliparis* and *Nectoliparis*, agreeing in habit with the former, and with the latter in having but five branchiostegal rays, while all other genera in this family have six.

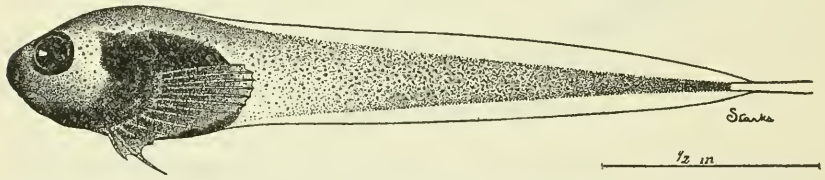

FIGURE 110.—LIPARISCUS NANUS. TYPE

No trace of a ventral disk. Vent posterior in position, lying in the area between the lower pectoral lobes. Pectoral fin greatly reduced but the two lobes connected, not separate and distinct as in *Nectoliparis*. Teeth simple, in narrow bands. Branchiostegals 5. Gill slit narrow, confined to the suprapectoral region.

Genotype.—*Lipariscus nanus* Gilbert.

LIPARISCUS NANUS Gilbert

Lipariscus nanus GILBERT, 1915, p. 358.

Type.—Cat. No. 75817, U.S.N.M.; 47 mm. long, from Station 4461, Monterey Bay 285 to 357 fathoms.

One paratype from the type locality, and three others from Station 4468, Monterey Bay, 32 to 309 fashoms.

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